



AD NO. \_\_\_\_\_  
TECOM PROJECT NO. 8-EG-335-ECG-021  
REPORT NO. ATC-8219

THIRD PARTIAL REPORT  
FOR THE  
FIRST ARTICLE TEST (FAT)  
OF THE  
TACTICAL QUIET GENERATOR (TQG) SETS (3-kW)

JOSE ANTONETTI  
SUPPORT EQUIPMENT TEAM  
SOLDIER AND FOREIGN SYSTEMS

U.S. ARMY ABERDEEN TEST CENTER  
ABERDEEN PROVING GROUND, MD 21005-5059

NOVEMBER 1999

Period covered:  
November 1998 through August 1999

20000110 141

Prepared for:  
PROJECT MANAGER - MOBILE ELECTRIC POWER  
SPRINGFIELD, VA 22150-3199

U.S. ARMY DEVELOPMENTAL TEST COMMAND  
ABERDEEN PROVING GROUND, MD 21005-5055

DISTRIBUTION LIMITED TO U.S. GOVERNMENT  
AGENCIES ONLY; TEST AND EVALUATION;  
NOVEMBER 1999. OTHER REQUESTS FOR THIS  
DOCUMENT MUST BE REFERRED TO PM-MEP,  
ATTN: AMCPM-MEP-T.

DTIC QUALITY INSPECTED 4

### DISPOSITION INSTRUCTIONS

Destroy this document when no longer needed. Do not return to the originator.

The use of trade names in this document does not constitute an official endorsement or approval of the use of such commercial hardware or software. This document may not be cited for purposes of advertisement.



**DEPARTMENT OF THE ARMY**  
**HEADQUARTERS, U.S. ARMY DEVELOPMENTAL TEST COMMAND**  
**314 LONGS CORNER ROAD**  
**ABERDEEN PROVING GROUND MD 21005-5055**

REPLY TO  
ATTENTION OF

8 DEC 1999

CSTE-DTC-TT-T (70-10p)


MEMORANDUM FOR Project Manager, Mobile Electric Power, ATTN: AMSEL-DSA-MEP-T,  
10205 Burbeck Road, Suite 105, Fort Belvoir, VA 22060-5863

SUBJECT: Approval of the Third Partial Report for the First Article Test  
(FAT) of the 3-kW Tactical Quiet Generator (TQG) Sets, TECOM Project No.  
8-EG-335-ECG-021

1. Subject document (encl 1) has been approved by this headquarters and is provided for your information.
2. Point of contact at this headquarters is Mr. John P. Mallamo,  
CSTE-DTC-TT-T, mallamoj@dtc.army.mil, DSN 298-1448/FAX DSN 298-9169 or 1454.

FOR THE COMMANDER:

Encl

  
ALAN L. YANKELONIS  
Chief, Tank-Automotive and Armaments  
Division  
Directorate for Test and Technology

CF:  
(Addressees specified in report distribution listing)

**BUY U.S. SAVINGS BONDS THROUGH THE PAYROLL DEDUCTION PLAN**

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
<small>Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.</small>				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE November 1999		3. REPORT TYPE AND DATES COVERED Third Partial (Nov 98 through Mar 99)
4. TITLE AND SUBTITLE THIRD PARTIAL REPORT FOR THE FIRST ARTICLE TEST (FAT) OF THE TACTICAL QUIET GENERATOR (TQG) SETS (3-kW)				5. FUNDING NUMBERS
6. AUTHOR(S) Antonetti, Jose				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Commander U.S. Army Aberdeen Test Center ATTN: CSTE-DTC-AT-SF-S Aberdeen Proving Ground, MD 21005-5059				8. PERFORMING ORGANIZATION REPORT NUMBER  ATC-8219
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Project Manager Mobile Electric Power ATTN: AMCPM-MEP-T Springfield, VA 22150-3199				10. SPONSORING/MONITORING AGENCY REPORT NUMBER  Same as Item 8
11. SUPPLEMENTARY NOTES None				
12a. DISTRIBUTION AVAILABILITY STATEMENT Distribution limited to U.S. Government Agencies only; Test and Evaluation; November 1999. Other requests for the document must be referred to PM-MEP, ATTN: AMCPM-MEP-T.				12b. DISTRIBUTION CODE
13. ABSTRACT (Maximum 200 words) A First Article Test (FAT) was conducted on 14 3-kW Tactical Quiet Generator (TQG) sets by the U.S. Army Aberdeen Test Center (ATC), Aberdeen Proving Ground (APG), Maryland, from November 1998 through March 1999. The FAT was conducted to determine the degree to which the 3-kW sets complied with the requirements of the Purchase Description (PD) for the tests conducted. The tests covered by this report are as follows: Human Factors Engineering (HFE), Voltage and Frequency Performance, Rail Impact, Road Transportability, Static Lift, and High-Altitude Electromagnetic Pulse (HAEMP) Environment.				
14. SUBJECT TERMS				15. NUMBER OF PAGES
				16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT  Unclassified		18. SECURITY CLASSIFICATION OF THIS PAGE  Unclassified		19. SECURITY CLASSIFICATION OF ABSTRACT  Unclassified
				20. LIMITATION OF ABSTRACT  SAR

## TABLE OF CONTENTS

### PAGE

### SECTION 1. EXECUTIVE DIGEST

1.1	SUMMARY .....	1-1
1.2	TEST OBJECTIVES .....	1-2
1.3	TESTING AUTHORITY .....	1-2
1.4	TEST CONCEPT .....	1-3
1.5	SYSTEM DESCRIPTION .....	1-3

### SECTION 2. SUBTESTS

2.0	INTRODUCTION .....	2.0-1
2.1	HUMAN FACTORS ENGINEERING (HFE) .....	2.1-1
2.2	VOLTAGE AND FREQUENCY PERFORMANCE .....	2.2-1
2.3	RAIL IMPACT.....	2.3-1
2.4	ROAD TRANSPORTABILITY .....	2.4-1
2.5	STATIC LIFT.....	2.5-1
2.6	HIGH-ALTITUDE ELECTROMAGNETIC PULSE (HAEMP) ENVIRONMENT.....	2.6-1

### SECTION 3. APPENDIXES

A	TEST CRITERIA .....	A-1
B	TEST DATA .....	B-1
C	REFERENCES .....	C-1
D	ABBREVIATIONS .....	D-1
E	DISTRIBUTION LIST .....	E-1

## SECTION 1. EXECUTIVE DIGEST

### 1.1 SUMMARY

Details of testing are provided in Section 2. A synopsis of the findings by subtest is as follows:

#### a. Human Factors Engineering (HFE).

(1) Control/display labeling. Of the 28 control, displays, and marking criteria, 26 conformed to the checklist, 1 was not applicable, and 1 (adjustment control) was easy to set and lock. The voltage knob did not set and lock. Three test participants agreed that it was difficult to differentiate between the colors of the load wires when they were dirty.

Control separation and control dimensions conformed to the requirements of MIL-STD-1472E.

(2) Design for maintainability. No maintenance access openings or workspaces inhibited the ability of the crew to perform maintenance, other than the location of the alternating current (AC) inverter connectors. It was difficult to reach the AC inverter connectors barehanded and not possible while wearing both arctic mittens.

(3) Hazards and safety. No hazards or safety problems were noted.

(4) Manual readability. The reading grade level (RGL) of the Operator's Manual (Technical Manual (TM) 9-6115-639-14) ranged from 6 to 14 with an overall grade level (OGL) of the 12 samples at 9. The RGL of the Maintenance Manual (TM 9-2815-257-24) ranged from 5 to 14 with an OGL of the 8 samples at 9.

(5) Four-man portability. The operational weight of the set did not meet the limit (four lifters) of the male-only population in accordance with MIL-STD-1472E. It also did not meet the male and female population of four lifters. The set required six lifters from the male population to lift the set from the ground to a surface not greater than 1.5 meters (5 ft). However, there were not a sufficient number of handholds for the set to be lifted by the male and female population.

b. Voltage and Frequency Performance. The tactical quiet generator (TQG) sets met the criteria for voltage and frequency performance.

#### c. Rail Impact.

(1) There was no degradation of electrical performance after comparison of the pre- and post-Rail Impact test data.

(2) The power plants (PPs) met the Rail Impact test criteria.

(3) The skid-mounted sets failed to meet the Rail Impact test criteria because of damage to the tie-down rings; however, because of the size and weight of the skid-mounted sets, the sets most likely will never be transported alone but will be packaged with other equipment.

d. Road Transportability.

(1) The inoperable hour meter did not prevent the set from producing power; however, the hour meter was used by the soldier to keep track of when to perform maintenance on the generator sets. Procedures for troubleshooting hour-meter problems should be included in the set manuals.

(2) There was no degradation of the generator's electrical performance during road testing.

(3) The sets met the criteria in paragraph 2.4.2.

e. Static Lift. Static lift testing indicated that the chains lightly contacted the generator housing. Shielding materials could be affixed to the sling chains where they contacted the generator housing to minimize abrasive wear. The trailers were considered stable and posed no significant interference problems with slings rigged in single-point suspension. However, the Natick Soldier System Center will perform the assessment for flight certification.

f. High-Altitude Electromagnetic Pulse (HAEMP) Environment. The HAEMP environment did not operationally affect the sets.

## 1.2 TEST OBJECTIVES

The test objectives were:

a. To test the safety; human factors; reliability, endurance, maintainability (REM); logistics supportability; environmental; physical; acoustical; and functional performance characteristics of the TQG sets for compliance with the Purchase Description (PD) (app C, ref 2).

b. To provide technical information to the Milestone IIIb In-Process Reviews (IPRs), which will be held for the type classification and production release of the skid-mounted TQGs and the material release of the TQG PPs.

### 1.3 TESTING AUTHORITY

On 10 July 1998, the U.S. Army Test and Evaluation Command (TECOM) (now the U.S. Army Developmental Test Command (DTC)) issued a Test Execution Directive (ref 1) to the U.S. Army Aberdeen Test Center (ATC) to conduct the First Article Test (FAT) of the 3-kW Tactical Quiet Generator (TQG) Sets, TECOM Project No. 8-EG-335-ECG-021.

### 1.4 TEST CONCEPT

a. Fourteen 3-kW TQG sets were tested by ATC from November 1998 to March 1999. The general concept was to establish adequate information through testing to provide a basis for a decision on whether the TQG sets met the criteria for the tests conducted as defined by the PD.

b. This partial report provides results of tests that were completed through March 1999. Findings covering the remainder of the tests will be presented in another report.

c. The tests covered by this report are:

- (1) HFE.
- (2) Voltage and Frequency Performance.
- (3) Rail Impact.
- (4) Static Lift.
- (5) HAEMP Environment.

### 1.5 SYSTEM DESCRIPTION

a. The TQG sets are type-1 (tactical), multifuel, diesel-engine-driven, single-phase electrical power sources rated at 0.8 power factor (pf) lagging, produced in two modes (II and III (400 and 60 Hz)), reconnectable for both single-phase, two-wire, 120-volt and three-wire, 120-/240-volt. The sets provided for testing were of the following modes, sizes, and quantities:

Size, kW	Mode	Quantity
3	III	10
3	II	4

b. The generator sets were designed to be trailer mounted for high mobility in direct support (DS) of military forces when the generated output does not require extensive distribution systems or transformation.



## SECTION 2. SUBTESTS

### 2.0 INTRODUCTION

a. This subtest contains details of testing conducted on the 3-kW TQG sets through August 1999.

b. The test items are referred to as TQG sets or set in the body of this report. The 14 3-kW TQG sets were identified throughout testing by assignment of test item identification numbers as outlined in Table 2.0-1. The 3-kW TQG sets (fig. 2.0-1 and 2.0-2) were configured in skid-mounted set configurations. The table also identifies the model numbers, modes, serial numbers, and initial hour-meter readings recorded upon receipt.

TABLE 2.0-1. TEST ITEM IDENTIFICATION NUMBERS

APG Item No.	Serial No.	Model No.	Mode	Initial Hour-Meter Reading
3-1	00112-001	MEP-831A	III	58.7
3-2	00112-002			56.2
3-3	00112-003			57.4
3-4	00112-004			55.1
3-5	00112-005			55.2
3-6	00112-006			53.5
3-7	00112-008			53.8
3-8	00112-009			53.1
3-9	00112-010			54.2
3-10	00112-011			52.6

c. The Detailed Test Plan (DTP) (ref 3) was used by ATC for test conduct with criteria based on applicable paragraphs in the PD. Some criteria not contained in the PD were derived by ATC and were DTC approved. Underlined portions of the criteria listed in the body of the report were not addressed during those subtests.

d. All instrumentation used during the FAT was calibrated to standards traceable to the National Institute of Standards and Technology (NIST).

e. MIL-STD-705C, Generator Sets, Engine Driven, Methods of Test and Instructions (ref 4), was used as a guide for conduct of all electrical tests.

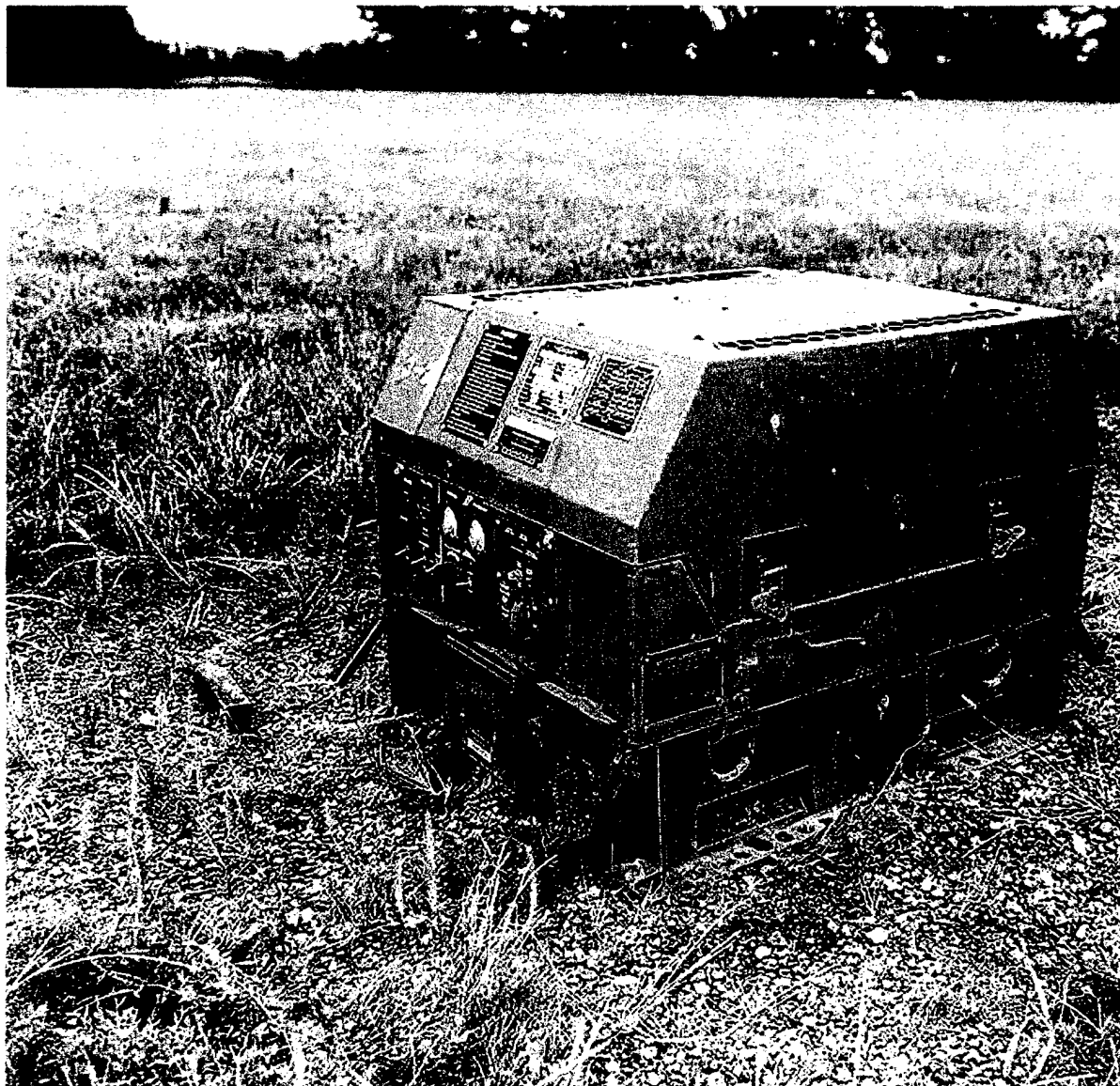


Figure 2.0-1. Right front view of skid-mounted 3-kW set.

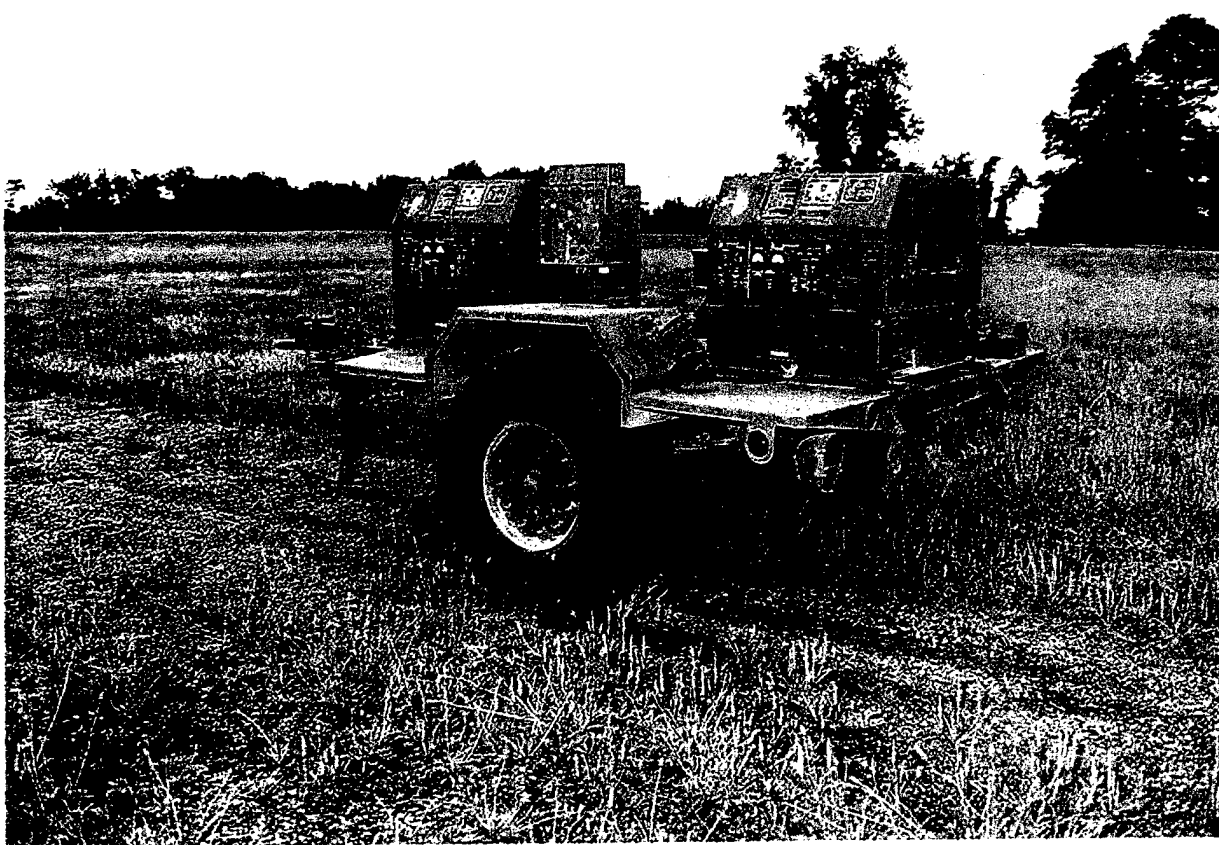


Figure 2.0-2. Right view of trailer-mounted 3-kW sets.

f. Test Incident Reports (TIRs) were furnished on all problems, failures, scheduled and unscheduled maintenance actions (UMAs), and significant observations or incidents noted throughout the test.

g. Incidents involving leaks were classified in accordance with the following leakage definitions contained in MIL-M-63036A (ref 5):

(1) Class I. Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.

(2) Class II. Leakage of fluid great enough to form drops but not enough to cause drops to drip from the item being checked/inspected.

(3) Class III. Leakage of fluid great enough to form drops that fall from the item being checked/inspected.

h. Equipment, supplies, and material for test conduct were provided in accordance with the SSP list.

i. Paragraph references listed in the criteria pertain to the applicable PD, unless otherwise stated.

j. Throughout all contractual testing, grease, oil, and fuel used were in accordance with Tables 2.0-2 through 2.0-4.

TABLE 2.0-2. SERVICE PRODUCT SPECIFICATIONS

Product Use	Ambient Air Temperature	
	0 to -25 °F	-10 to +125 °F
Oil:		
For general-purpose lubrication	VV-L-800 (OE/HDO)	MIL-L-3150 (OE/HDO)
Gear	MIL-L-2105	MIL-L-2105
Grease:		
For sealed bearings	MIL-G-23827 (GAA)	MIL-G-23827 (GAA)
For general lubrication, including wheel bearings and gear oil	MIL-G-10924 (GAA)	MIL-G-10924 (GAA)

TABLE 2.0-3. ENGINE OIL SERVICE PRODUCT SPECIFICATIONS

Ambient Air Temp, °F	Lubricant	Viscosity	Specification
5 to +120	OE/HDO	15/40	MIL-PRF-2104G
-15 to + 40	OE/HDO	10	MIL-PRF-2104G
15 to + 90	OE/HDO	30	MIL-PRF-2104G
30 to +120	OE/HDO	40	MIL-PRF-2104G
-25 to + 40	OEA	-	MIL-L-46167B
-25 to 120	-	-	TC-W

TABLE 2.0-4. FUEL SERVICE PRODUCT SPECIFICATIONS

Ambient Air Temp, °F	Fuel	Description	Specification
Below -25	DL-A	Arctic grade	A-A-52557
-26 to 0	DL-1	Winter grade	A-A-52557
0 and above	DL-2	Regular grade	A-A-52557
0 and above	DF	Referee grade	MIL-F-46162
-72 to 100	JP-4	Turbine fuel	MIL-PRF-5624
-58 and above	JP-8	Turbine fuel	MIL-T-83133
-51 to 140	JP-5	Turbine fuel	MIL-PRF-5624

DF = Diesel fuel.

DL = Low-sulfur diesel fuel.

JP = Turbine fuel.

k. Separate log books were maintained on the test items and included a chronological sequence of the events (tests, unscheduled and scheduled maintenance, etc.) that occurred to each item while it was at ATC.

l. Unless otherwise stated, all testing was conducted at the 120-/240-volt single-phase connection on the 240-volt output.

## 2.1 HUMAN FACTORS ENGINEERING (HFE)

### 2.1.1 Objective

The objective of this test was to assess the human factor characteristics of the TQG sets.

### 2.1.2 Criteria

a. The set shall be designed in accordance with criteria of design for Human Factors Engineering as described in MIL-STD-1472E (ref 6). The set shall be transportable, operable and maintainable during day and night by 5th percentile through 95th percentile soldiers when wearing the clothing which is appropriate to the environments described in paragraph 3.6 and 3.8.1, including Arctic and MOPP IV clothing and mittens. Particular design attention shall be given, but not limited to the following paragraphs of MIL-STD-1472E: 4 (General Requirements), paragraph 5.1 (Control/Display Integration), 5.2 (Visual Display), 5.3 (Audio Display), 5.4 (Controls), 5.5 (Labeling), 5.6 (Anthropometry), 5.9 (Design for Maintainability), and 5.13 (Hazards and Safety). Specific citations of MIL-STD-1472 contained elsewhere in this Purchase Description shall not preclude this general requirement (PD, para 3.26).

b. CGSAs in all operating configurations must: ... Be man portable (4-man) for the 3 kW skid mounted set; ... (Required Operational Capability (ROC) (ref 7), para 5b).

Note: PD, paragraphs 3.6 and 3.8.1 refer to starting and operating the generators when personnel are outfitted in nuclear, biological, and chemical (NBC) or mission-oriented protective posture (MOPP) IV clothing without special tools.

### 2.1.3 Test Procedures

#### a. Anthropometric and Demographic Data.

(1) Anthropometric data. In order to establish percentile rankings for each of the daily operation, maintenance, and performance exercises, test participants' anthropometric dimensions were measured and compared to the 5th through the 95th percentile values for ground troops from the U.S. Army Anthropometric Survey. Percentile rankings assisted in evaluation in the event of system inadequacies or operator complaints. The standard distribution is presented in Table 2.1-1.

TABLE 2.1-1. DISTRIBUTION OF ANTHROPOMETRIC MEASUREMENT DATA

Measurements	5th Percentile				95th Percentile			
	Male		Female		Male		Female	
	cm	in.	cm	in.	cm	in.	cm	in.
Stature (nude)	164.29	64.84	152.78	60.15	186.65	73.48	173.73	68.4
Index finger reach	79.60	31.34	72.82	38.67	93.17	36.68	85.52	33.67
Sitting height, erect	85.45	33.64	79.53	31.31	97.19	38.26	91.02	35.84
Eye height, sitting	73.50	28.94	68.46	26.95	84.8	33.39	79.43	31.27
Knee height, sitting	51.44	20.25	47.40	18.66	60.57	23.85	56.02	22.05
Buttock-knee length	56.90	22.40	54.21	21.34	66.74	26.28	63.98	25.19
Hip breadth, standing	30.97	12.19	30.78	12.12	37.65	14.82	38.15	15.02
Bideltoid (shoulder) breadth, sitting	44.99	17.71	39.70	15.63	53.48	21.05	47.17	18.57
Buttock-popliteal length	45.81	18.04	44.00	17.32	54.44	21.48	52.77	20.78
Hand length	17.87	7.04	16.50	6.50	21.06	8.29	19.69	7.75
Hand breadth	8.36	3.29	7.34	2.89	9.76	3.84	8.56	3.37
Weight (kg)	61.59	135.78	49.64	109.43	98.07	216.21	76.98	169.72

(2) Demographic data. Demographic data were compiled of the same test participants and included the following:

- (a) Gender
- (b) Job position (for this test).
- (c) Length of experience (in job position).
- (d) Age.

b. Operator/Maintainer Performance Tasks. While the generators were cold and not running, the test participants completed the performance tasks three times each in four different clothing ensembles. The first ensemble consisted of street clothes for daytime and nighttime baseline data. The second and third ensembles were cold weather gear, consisting of the arctic parka with hood, mittens and again with trigger-finger mittens. The fourth ensemble consisted of NBC gear, including the M45 mask and 14-mm butyl gloves. The ability of the test participants to perform maintenance tasks was determined by comparing performance times required to complete the following tasks:

- (1) Checking, filling, and changing engine oil.

- (2) Replacing engine oil filter(s).
- (3) Replacing air filter element.
- (4) Connecting load cable.
- (5) Replacing fuel filter(s).
- (6) Performing other common field maintenance actions such as filling fuel tank, battery, adjusting belts, etc.

Inability to perform/difficulties in performing any maintenance tasks were recorded.

c. Subjective Assessment.

(1) New equipment training (NET). Contractor representatives conducted NET for all test participants and test personnel prior to the initiation of the test. The four-day training familiarized all test participants with all aspects of the 3-kW operation, functionality and maintenance through handouts, manuals, viewgraphs, instruction, and hands-on practical exercises. The adequacy of NET was determined subjectively by using a questionnaire relating to specific areas of training prior to testing of the TQG sets. The assessment was made using the 6-point rating scale of Appendix B, Table B-2.1-5 in the questionnaire and was administered to operators after the completion of NET.

(2) Questionnaires/interviews. Human factors questionnaires were administered to test participants and pertained to operating and maintaining the equipment. A section of each questionnaire was devoted to task performance while wearing NBC and arctic gear.

Interviews were conducted to determine the test participants' opinions of the overall operation, maintenance, and performance of the generator.

(3) Checklists. Checklists were prepared and completed by a HFE engineer on the following elements of system design:

- (a) Controls, displays, and markings.
- (b) Maintainability.

(4) General HFE observations. Observations were made throughout all testing to gain additional information on any HFE-related problems. Comments and informal interviews, in addition to HFE observations, were documented throughout testing to provide subjective input to assess the TQG sets. These interviews, comments, and observations were used to augment data from other HFE subtest supplements and are integrated into the analysis of the TQG sets.



d. Control/Display/Labeling Assessment. Observations were made of all controls, displays, and labeling with respect to HFE design practices (ref 6). Control separation and control dimensional measurements were taken to determine if any design problems existed. The ability of the operator to successfully operate the sets while barehanded and when wearing arctic and NBC gloves was observed during day and night.

e. Workspace and Maintenance Access Measurements. Maintenance access openings and workspaces were observed with respect to the ability of the crew to perform maintenance and to determine compatibility with anthropometric dimensions for 5th through 95th percentile personnel while outfitted in arctic and NBC protective ensembles and street clothes, which consisted of T-shirt, jeans, and work boots.

f. Manual Readability. The RGLs of the operation and maintenance manuals were determined by conducting a readability test in accordance with Test Operations Procedure (TOP) 1-2-609 (ref 8). Twelve text samples from TM 9-6115-639-14 and eight text samples from TM 9-2815-257-24 were used to determine the OGL.

#### 2.1.4 Test Findings

a. Anthropometric measurements and demographic data are presented in Table 2.1-2.

b. Performance times of critical maintenance tasks while maintainers were outfitted in arctic and NBC ensembles are located in Appendix B, Table B-2.1-4. Test participant A was available only for three of the five performance task trials and test participant D was only available for four of the five trials. Inability/difficulty performing the maintenance tasks was as follows:

(1) The wing nut on the air filter was recessed and too small, making it difficult to remove (see app B, fig. B-2.1-1) while the test participant was wearing arctic mittens.

(2) While wearing arctic mittens, one test participant could not change the O-ring on the oil filter (see app B, fig. B-2.1-2).

(3) While wearing arctic mittens, one test participant could not remove the oil filter without removing the mittens.

(4) It was difficult to use the load cable wrench handle with both mitten types (see app B, fig. B-2.1-3).

(5) The length of the load cable wrench cord inhibited the test participant from turning the bolts (see app B, fig. B-2.1-4).

TABLE 2.1-2. TEST PARTICIPANT (IN STREET CLOTHING) DEMOGRAPHIC AND ANTHROPOMETRIC DATA

Test Participant	A		B		C		D		E	
Generator No.	3-3		3-2/4		3-2/4		3-3		3-3	
Gender	F		M		M		M		F	
Job position	Eng Tech II		Eng Tech II		Eng Tech II		Eng Tech II		Eng Tech II	
Length of experience	Training		6 Years		5 Years		4 Years		Training	
Age	33		30		33		25		31	
Handedness	R		R		R		R		R	
	cm	Percentile	cm	Percentile	cm	Percentile	cm	Percentile	cm	Percentile
Stature	163	52	184	89	164	31	172	2	163	59
Index finger reach	75.6	21	91	88	81.2	13	82	18	74.2	12
Sitting height	80.5	7	88.2	18	79.1	<1	81.4	<1	82.4	22
Eye, sitting height	69.2	8	79.6	54	70.6	<1	70.6	<1	72.4	33
Knee height, sitting	51.1	45	59.4	89	56.3	56	56.6	61	54.9	90
Buttock-knee length, sitting	56.5	22	63.6	74	54.7	<1	55.4	1	57.5	32
Hip breadth, standing	34.5	56	40.7	>100	36.3	88	35.7	79	32.6	24
Bideltoid (shoulder) breadth	37.6	<1	51.7	84	49.7	59	49.1	49	39.5	4
Hand length	16.6	7	18.9	34	19.3	49	19	37	17	14
Hand breadth	7.6	19	9	49	8.6	15	8.8	29	7.6	19
Weight	135	49	200	86	194	82	185	74	138	57

(6) The hose on the fuel filter slipped off when opening the fuel valve (see app B, fig. B-2.1-5). While wearing any of the three types of hand wear, the test participants could not tell when the drain hose had fallen off the fuel filter.

c. Subjective Assessment.

(1) The NET questionnaire summary is provided in Appendix B, Table B-2.1-5. The summary is broken down into five categories. The first category (instructors) was rated with an overall rating of 6.19 on a scale of 1 to 9 with 1 unsatisfactory and 9 outstanding. The second category (instruction) rated average on all aspects indicated. The third category (practical exercises) rated above average with the percentage of hands-on exercises at 30 percent. The fourth category (assignments and references) rated 3.93 on a scale of 1 to 9 with 1 as never and 9 as always. Assignments were also rated at 3.60 on a scale of 1 to 9 with 1 being too simple and 9 too hard. Manual design rated average on ease of use. The last category (examinations) rated above average; the performance-type exams rating was 3.73 on a scale of 1 to nine 9 with 1 being never and 9 as always.

(2) Results of HFE questionnaires administered to test personnel are presented in Appendix B, Table B-2.1-1. Interview comments are as follows:

(a) Test participant A had difficulty with removing the wing nut on the air filter while wearing the arctic mittens.

(b) Test participant B thought the system was easy to use, yet the load cable wrench was difficult to use.

(c) Test participant C thought that the pull start rope should be at a higher angle instead of pointing straight out. He had to take the gloves off for the oil drainage bolt when changing the oil.

(d) Test participant D had no comment.

(e) Test participant E had difficulty tightening the load cables up tight enough with the load cable wrench while wearing arctic mittens. She had difficulty with the hose on the fuel filter slipping off when opening the fuel valve to drain.

(3) Results from the HFE design and maintainability checklist are presented in Appendix B, Tables B-2.1-2 and B-2.1-3.

d. The control/display/labeling assessment and the control diagram results are presented in Appendix B, Table B-2.1-6.

e. The workspace and crew maintenance access was more difficult with the mittens on than while barehanded, as expected. The load cable wrench connecting cord was too short and had been broken after the baseline performance tasks to use the wrench more easily.

f. The RGLs and OGLs of the operation and maintenance manuals are presented in Appendix B, Table B-2.1-7. The following typographical errors were noticed in TM 9-2815-257-24 while collecting RGL data.

Page No.	Error
B-3	The sentence in paragraph d needs to be capitalized.
3-16	A3. If replacement of manifold (6) is required, the flywheel cover must be removed (para 4-13).
2-2	The last sentence in paragraph d: The valve closes just before the piston reaches it high point.
Contents	The contents states that there are Appendixes F through H. These are not available.

g. Four-Man Portability. The operational weight of the skid-mounted set is 134.6 kg (296.8 lb). The lifting limit for four males to lift the set from the ground to a surface not greater than 1.5 meters (5 ft) is 101.6 kg (224 lb) in accordance with MIL-STD-1472E, paragraph 5.9.11.3.1. The lifting limit for four lifters from the male and female population to lift the generator set from the ground to a surface not greater than 1.5 meters is 67.2 kg (148 lb). There are sufficient numbers of handholds for the set to be lifted by six male lifters. There are not a sufficient number of handholds for the set to be lifted by more than four lifters from the male and female population.

#### 2.1.5 Technical Analysis

a. Anthropometric and demographic data were used to analyze each test participant, based on relative percentile ranking and against individual performance. Data were further analyzed to present any system shortcomings caused by compatibility accommodations for the 5th through 95th percentile male and female operators. Female percentiles for all measurements were within the 5th to 95th percentile except bideltoid (shoulder) breadth; both were below the 5th percentile. Male percentiles ranged from less than 1 percent to greater than 100 percent, yet there were no shortcomings of the system that were directly related to test participant measurements. Most importantly, the hand measurements (critical to operating and maintaining the system) of both male and females fell between the 5th and 95th percentiles.

b. All operator performance times on the tasks were affected by three things. First, the generators were cold during the performance tasks, causing the oil to be thick and run slowly through the drainage hole, excessively increasing the time. Otherwise, the time for changing the oil was not restricted through the ability of the operator. Second, the generators had a gel battery, which obviated the need to check the battery fluid, therefore reducing time during battery

preventive maintenance checks and services (PMCS). Third, the wire connecting the load cable wrench to the generator was intact during the baseline task (normal work clothes with bare hands). Since the wire was too short to complete the other tasks, it was detached for all other trials. This is shown in the average in time working with bare hands at night without the connecting wire being smaller than that for working with the bare hands during the day with the wire connected. Follow-up interviews and additional data showed that if the connecting wire were elongated, the performance times would be reduced.

Test participants commented as follows: The wing nut on the air filter is recessed and too small to loosen, the oil filter could not be removed, and the handle on the load cable wrench is too small to manipulate while wearing arctic mittens. Proposed corrective actions would be to enlarge the air filter wing nut and oil filter knob and elongate the load cable wrench handle. In addition, comments and observations concluded that test participants were unable to remove the O-ring from the oil filter while wearing both types of arctic mittens. Further investigation revealed that the O-ring can be removed using a screwdriver as seen in Appendix B, Figure B-2.1-6. The task of changing the oil filter is at the organizational maintenance level where a screwdriver would be available to complete this task while wearing arctic mittens.

c. Subjective Assessments.

(1) The instructors and examinations of the NET were rated above average; instruction, exercises, and manual design rated average. The assignment rating indicates that assignments were given less than anticipated and were less difficult than anticipated.

(2) The HFE questionnaire rating scale was 1 to 6 with 1 being extremely poor and 6 excellent, with an average rating of 3.5. There were three questions that rated below average on generator adequacy in the opinion of the operator.

(a) The first question rated 3.0 for the space provided to service the generator.

(b) The second question rated 3.4 for the adequacy of the illumination of instruments during night operation. HFE observations and test participant comments during testing substantiate these ratings. There is no illumination lighting within the generator hatch for nighttime maintenance. The performance times show that the test participants were still able to perform the maintenance of the generator, yet, in their opinion, there should be more space provided and nighttime illumination to service the generator.

(c) The third question rated below average was 3.2, operation and maintenance while wearing arctic clothing. Further analysis of the performance trials showed that it took longer for the test participants to perform tasks with arctic gear than without. HFE observations and test participant interviews substantiate this below-average rating. Possible corrective actions were previously discussed under performance tasks.

(3) Of the 28 control, displays, and marking criteria, 26 conformed to the checklist, 1 was not applicable, and 1 (adjustment control) was easy to set and lock. The voltage knob did not set and lock. Test participant C said that the voltage knob vibrated loose and it would be nice to have the old knobs that set and lock. Three test participants agreed that it was difficult to differentiate between the colors of the load wires when they were dirty.

Of the 43 maintainability criteria, 37 conformed to the checklist, 1 was not applicable, and 5 did not conform. Nonconforming items, test participants' follow-up interview comments, and possible corrective actions are presented in Table 2.1-3.

TABLE 2.1-3. SUGGESTED IMPROVEMENTS

Items	Comments	Possible Corrective Action
2. Covers (d) Structural members, other components, etc., do not interfere with removal of a cover.	Have to disconnect the fan to take the cover off.	Put the quick-release (app B, fig. B-2.1-7) for disconnecting the fan wires at the hinge (app B, fig. B-2.1-8).
2. Covers. (i) Captive nuts and bolts are used where feasible.	The cover and control panel could use captive nuts and bolts.	Put captive nuts and bolts on the cover and control panel.
3. Location of Replaceable Components. a. Large components which are difficult to remove are mounted so that they do not prevent access to other components.	The muffler is in the way when taking the starter off. Appendix B, Figure B-2.1-9 shows the set with the muffler and Appendix B, Figure B-2.1-10 shows the set without the muffler.	Have a quick-release mechanism for removing the muffler for easier access to the starter.
3. Location of Replaceable Components. e. Delicate components are so located or guarded that they will not be damaged while the unit is being handled or worked on.	The bottom of the solenoid has broken off behind the battery (app B, fig. B-2.1-11).	Place a guard around the solenoid to protect it from breakage.
5. Connectors. d. Plugs are designed so that it is impossible to insert the wrong plug in a receptacle.	The connectors on the AC inverter can be inserted into the wrong plug (app B, fig. B-2.1-12).	Make key connectors different on the AC inverter plugs.

d. Control separation and control dimensions conformed to the requirements of MIL-STD-1472E.

e. No maintenance access openings or workspaces were observed to inhibit the ability of the crew to perform maintenance, other than what was already discussed previously about the location of the AC inverter connectors. It was difficult to reach the AC inverter connectors barehanded and not possible with both arctic mittens.

f. The RGL of Operator's Manual TM 9-6115-639-14 ranged from 6 to 14 with an OGL of the 12 samples at 9. The RGL of Maintenance Manual TM 9-2815-257-24 ranged from 5 to 14 with an OGL of the 8 samples at 9.

g. Four-Man Portability. The operational weight of the set did not meet the limit of the male-only population of four lifters in accordance with MIL-STD-1472E. The weight also did not meet the male and female population of four lifters. The set requires six lifters from the male population to lift the set from the ground to a surface not greater than 1.5 meters (5 ft). However, there are not a sufficient number of handholds for the set to be lifted by the male and female population.

h. Table 2.1-4 lists the criteria that were met or partially met.

TABLE 2.1-4. SUMMARY OF HFE RESULTS

HFE Criteria	Analysis (Within Report) Paragraph	Met/Partially Met/Not Met
Control/Display Integration	2.5.5c(3)	Partially met
Visual Display	2.5.5c(2)	Met
Controls	2.5.5d	Met
Labeling	2.5.5c(2)	Met
Anthropometry	2.5.5a	Met
Design for Maintainability	2.5.5c(3)	Partially met
Hazards and Safety	2.5.5c(4)	Met

Five of the seven criteria were met and two were partially met. The control/display integration and design for maintainability criteria will change from partially met to met with the respective corrective actions discussed in the appropriate paragraphs.

## 2.2 VOLTAGE AND FREQUENCY PERFORMANCE

### 2.2.1 Objectives

The objectives of this test were:

- a. To determine if the engine-governor and regulator-exciter were capable of maintaining specific engine speed and output voltage for constant loads and during the application and removal of various loads.
- b. To determine if voltage and frequency would recover within the specified time limits.
- c. To determine if voltage and frequency transients were within the allowable limits.

### 2.2.2 Criteria

a. Electrical Performance. Set electrical performance shall be as specified herein. Set rating shall be 3.0 kW at 4000 feet altitude and 95 °F. If the operational weight of the set with the battery removed is 326 pounds or less, a set rating of 3.0 kW at 1000 feet altitude and 107 °F is acceptable (3.0 kW at 4000 feet and 95 °F is still preferred). Components of the set shall not be damaged (para 6.3.17) when the set is operated continuously at all possible frequency and voltage adjustments. The set shall provide the applicable load rating (para 3.8.2) at the output terminal under all operating conditions specified herein (PD, para 3.7).

b. Frequency Regulation. The frequency regulation (para 6.3.23) from no-load to rated load and from rated load to no-load shall be not more than 3.00 percent (PD, para 3.33.1).

c. Frequency Short-Term Steady-State Stability (30 seconds). At every constant load from no-load to rated load, the system shall maintain frequency within a bandwidth equal to 4.00 percent of rated frequency. The system shall not permit repetitive frequency variations, even though within the allowable 4.00 percent band (PD, para 3.33.2).

d. Frequency Transient Performance. Following any sudden increase in load, including from no-load to rated load, the governing system, if applicable, shall reestablish stable engine operating conditions within 4.00 second and the maximum transient frequency change below the new steady-state frequency (undershoot, para 6.3.24) shall be not more than 4.00 percent of rated frequency. Following any sudden decrease in load, including from rated load to no-load, the governing system shall re-establish stable engine operating conditions within 6.00 seconds, the maximum transient frequency change above the new steady-state frequency (overshoot) shall be not more than 5.00 percent of rated frequency (para 6.3.24) (PD, para 3.33.5).

e. Voltage Regulation. The voltage regulation (para 6.3.23) from no-load to rated load and from rated load to no-load shall be not more than 4.00 percent of the rated voltage for all voltage connections throughout the voltage ranges specified (PD, para 3.34.14.1).



f. Voltage Short-Term Stability (30 seconds). At every constant load from no-load to rated load, the voltage at the set terminals shall remain within a bandwidth equal to 2.00 percent of rated voltage (PD, para 3.34.14.2).

g. Voltage Dip and Rise. Performance of the set under transient conditions, including from no load to rated load (as measured by a magnetic oscillograph) shall be as follows: With the set initially operating at rated frequency and rated voltage, and following any sudden change in load from no-load to rated load, the instantaneous voltage shall not dip (para 6.3.22) more than 30.00 percent of rated voltage and shall recover (para 6.3.19) within 3.00 seconds. Overshoot or undershoot of the final voltage shall not exceed the initial voltage transient in amplitudes. The above requirements shall also apply when the load is suddenly changed from rated load to no-load, except that the initial voltage transient shall involve a voltage rise (para 6.3.22) not to exceed 30.00 percent of rated voltage (PD, para 3.34.14.5).

Note: Underlined portion was not performed. The ATC Advanced On-Board Computer System (ADOCS) was the primary recording equipment.

#### 2.2.3 Test Procedures

a. The performance of the engine-governor and regulator-exciter was assessed during the reliability/endurance and other performance tests by conducting MIL-STD-705C, Test Method 608.1b. An initial performance test was conducted during the initial inspection to establish a baseline for comparison with subsequent tests. This initial performance test was performed from rated load to no-load and the fractional loads of three-quarters, one-half, and one-quarter to no-load. All succeeding tests were conducted from rated load to no-load only. The sets were tested at 120/240 volts.

b. The ADOCS was used to obtain the voltage and frequency performance parameters.

#### 2.2.4 Test Findings

The initial performance test established a baseline for performance of the sets. The results of all performance tests performed are presented in Appendix B, Tables B-2.2-1 through B-2.2-20. There were no requirement failures of the sets throughout the test.

#### 2.2.5 Technical Analysis

The TQG sets met the criteria for the voltage and frequency performance.

## 2.3 RAIL IMPACT

### 2.3.1 Objectives

The objectives of this test were:

- a. To determine if the TQG sets could withstand, without damage, the shocks normally encountered during railroad shipping.
- b. To determine if the tie-down method was adequate for rail shipment.

### 2.3.2 Criteria

a. Rail Tie-Down Procedures. A procedure for mounting of the set to a rail flat car for rail shipment (transportation) shall be provided. Mounting of the sets shall be in accordance with standard loading and bracing methods as shown in Section 6 of the Association of American Railroads (AAR), Standard Rules Governing the Loading of Department of Defense Material on Open Top Cars (ref 9) (PD, para 3.13.2).

b. Rail Transport. The set while facing forward, aft and to either side and the power plant assembly (para 3.19.4.2) while facing forward and aft shall be capable of being rail transported (para 6.3.11) on wood-decked, open top railcars without damage (para 6.3.10 and 6.3.17) (PD, para 3.13.4).

c. Damage. Damage is defined as any failure (para 6.3.14), rough handling damage (para 6.3.10) or degradation in life. The blowing (opening) of a replaceable fuse is not considered damage, provided it is performing its intended function (PD, para 6.3.17).

d. Rough Handling Damage. Rough handling damage is defined as any condition resulting in malfunctioning of the set, liquid leakage, deformation, loosening, breakage, or change of fit of any component or part (PD, para 6.3.10).

e. Railroad Transportation. Railroad transportation shall be interpreted to mean impact speeds up to and including 8 mph under test conditions specified in paragraph 4.7.4 and Appendix D (PD, para 6.3.11).

### 2.3.3 Test Procedures

- a. The set fuel tanks were filled to one-half capacity with all other fluids at their normal operating levels.

b. The flatcar/unit configuration was impacted against one stationary, standard USAX flatcar having a weight of 44,680 kg (98,500 lb). Steel plates weighing 68,360 kg (150,700 lb) were loaded and secured with steel bracing to the stationary car, for a total weight of 113,040 kg (249,200 lb).

c. The Rail Impact test was conducted on a straight, flat section of track. The air and hand brakes were engaged on the stationary car. The slack in the coupler on the secondary car was removed before each impact. A diesel-electric locomotive set the flatcar in motion at the desired speed. The engineer used a calibrated noncontact fifth wheel as a speed indicator.

d. The actual impact speeds were measured with an electric timer that was activated by contact of the wheels on the moving flatcar. The electric timer used two microswitches (start and stop switches) that were placed 1.5 meters (5 ft) apart; the stop switch being located 2.1 meters (7 ft) from the point of impact.

e. After each impact, the generator sets were inspected for liquid leakage, deformation, loosening, breakage, or change of fit of any component or part.

#### 2.3.4 Test Findings

##### a. Rail Impact of PP.

(1) General. The PPs were mounted in same direction to each other with their longitudinal axis parallel to the length of the flatcar. Photographs of the securement system are presented in Appendix B, Figures B-2.3-1 through B-2.3-3.

(2) The actual rail impact test speeds are presented in Table 2.3-1.

TABLE 2.3-1. RAIL IMPACT TEST SPEEDS

Impact No.	Nominal Speed		Actual Speed		Orientation
	km/ hr	mph	km/hr	mph	
1	6	4	6.9	4.3	Forward <sup>a</sup>
2	10	6	9.6	6.0	Forward
3	13	8	13.0	8.0	Forward
4	13	8	13.2	8.1	Reverse

<sup>a</sup>The forward direction refers to the front of the trailers facing toward the point of impact.

(3) No damage or deformation was observed to the generator sets or to the trailers during or after the test.

(4) Electrical performance data are presented in Appendix B, Tables B-2.2-13 through B-2.2-20.

b. Rail Impact of Skid-Mounted Sets.

(1) General. The Rail Impact test was conducted on three 60-Hz skid-mounted sets (No. 3-2, 3-3, and 3-5). Photographs of the securement system are presented in Appendix B, Figures B-2.3-4 and B-2.3-5.

(2) The actual Rail Impact test speeds are presented in Table 2.3-2.

TABLE 2.3-2. RAIL IMPACT TEST SPEEDS

Impact No.	Nominal Speed		Actual Speed		Orientation
	km/hr	mph	km/hr	mph	
1	6	4	6.4	4.0	Forward <sup>a</sup>
2	10	6	9.6	6.0	Forward
3	13	8	13.4	8.3	Forward
4	13	8	NC	NC	Reverse

<sup>a</sup>The forward direction refers to the front of the generators facing toward the point of impact.

NC = Not conducted.

(3) No damage or deformation was noted following the 4- and 6-mph impacts. However, after the forward 8-mph impact, the following damage were noted:

(a) The front tie-down rings on all three generators were damaged or deformed.

(b) Both front tie-down rings broke on set No. 3-3 (app B, fig. B-2.3-6 and B-2.3-7), farthest from the point of impact.

(c) The center generator (set No. 3-2) shifted sideways during the impact (app B, fig. B-2.3-8), and the left tie-down ring was deformed (app B, fig. B-2.3-8). The left tie-down ring was also deformed (app B, fig. B-2.3-9) on generator set No. 3-5.

(d) The 8-mph reverse impact was not conducted.

(4) Electrical performance data are presented in Appendix B, Tables B-2.2-5, B-2.2-6, B-2.2-9, and B-2.2-10.

c. Second Rail Impact of Skid-Mounted Sets.

(1) General. The Rail Impact test was conducted on four 60-Hz skid-mounted sets (No. 3-2, 3-3, 3-4, and 3-5). Photographs of the securement system developed by the manufacturer are presented in Appendix B, Figures B-2.3-10 and B-2.3-11.

b. The actual Rail Impact test speeds are presented in Table 2.3-3.

TABLE 2.3-3. RAIL IMPACT TEST SPEEDS

Impact No.	Nominal Speed		Actual Speed		Orientation
	km/hr	mph	km/hr	mph	
1	6	4	6.6	4.1	Forward <sup>a</sup>
2	10	6	9.6	6.0	Forward
3	13	8	12.8	8.0	Forward
4	13	8	13.0	8.1	Reverse

<sup>a</sup>The forward direction refers to the front of the generators facing toward the point of impact.

(3) No damage or deformation was noted following the 4- and 6-mph impacts. During the forward 8-mph impact, the front tie-down rings on all four generators were deformed (app B, fig. B-2.3-12 and B-2.3-13).

No additional deformation was noted following the reverse 8-mph impact. Also, none of the tie-downs rings broke during the impacts.

(4) Electrical performance data are presented in Appendix B, Tables B-2.2-3 through B-2.2-10.

d Third Rail Impact of Skid-Mounted Sets.

(1) General. The Rail Impact test was conducted on two 60-Hz (No. 3-14 and 3-15) and two 400-Hz (No. 3-25 and 3-28) skid-mounted sets. The manufacturer modified the sets by installing harden tie-down rings on the sets prior to the rail impact test. A photograph of the rail impact configuration is presented in Appendix B, Figure B-2.3-14. The generators were instrumented with 18 uniaxial accelerometers in six measurement locations.

(2) The actual Rail Impact test speeds are presented in Table 2.3-4.

TABLE 2.3-4. RAIL IMPACT TEST SPEEDS

Impact No.	Nominal Speed		Actual Speed		Orientation
	km/hr	mph	km/hr	mph	
1	6	4	6.7	4.2	Forward <sup>a</sup>
2	10	6	10.1	6.3	Forward
3	13	8	13.3	8.3	Forward
4	13	8	NA	NA	Reverse

<sup>a</sup>The forward direction refers to the front of the generators facing toward the point of impact.

NA = Not applicable.

(3) No damage or deformation was noted following the 4- and 6-mph impacts. During the forward 8-mph impact on those generator sets oriented so that the tie-down rings were front and rear, the tie-down rings on the rear deformed. On those generator sets oriented so that the tie-down rings were on either side, the welds holding the tie-down rings to the sets broke. Photographs of this damage are presented in Appendix B, Figures B-2.3-15 and B-2.3-16.

Amplitude distribution tables for each of the impacts can be found in Appendix B, Tables B-2.3-1 through B-2.3-3. Time history plots for the 8-mph forward impact can be found in Appendix B, Figures B-2.3-17 through B-2.3-33.

### 2.3.5 Technical Analysis

a. There was no degradation of electrical performance after comparison of the pre- and post-Rail Impact test data.

b. The PPs met the Rail Impact test criteria.

c. The skid-mounted sets failed to meet the Rail Impact test criteria because of damage to the tie-down rings; however, because of the size and weight of the skid-mounted sets, the sets most likely will never be transported alone but will be packaged with other equipment.

## 2.4 ROAD TRANSPORTABILITY

### 2.4.1 Objective

The objective of this test was to determine if the TQG sets were capable of withstanding the shock and vibration of off-road, cross-country transport without structural or functional damage.

### 2.4.2 Criteria

a. Utility Vehicle and Trailer Transport. The set shall be capable of being transported by utility vehicle or trailer transportation (para 6.3.12) while facing forward, aft, or to either side without damage (para 6.3.10 and 6.3.17) (PD, para 3.13.5).

b. Rough Handling Damage. Rough handling damage is defined as any condition resulting in malfunctioning of the set, liquid leakage, deformation, loosening, breakage, or change of fit of any component or part (PD, para 6.3.10).

c. Damage. Damage is defined as any failure (para 6.3.14), rough handling damage (para 6.3.10) or degradation in life. The blowing (opening) of a replaceable fuse is not considered damage, provided it is performing its intended function (PD, para 6.3.17).

### 2.4.3 Test Procedures

a. All maintenance operations required during the course of testing were performed by trained civilian or manufacturer's personnel, using those items specified in the SSP and following the proposed maintenance concept. All crew through general support (GS) maintenance operations were monitored to accumulate required data; operator's daily checks and services were observed sufficiently to obtain a representative time to perform those tasks. The Automated Data Collection System (ADACS) was used in the collection and analysis of all maintenance data.

#### b. Road Test.

(1) The test items were subjected to four cycles of the road schedule shown in Table 2.4-1.

(2) At the beginning and end of each driving period, the generator sets were started and operated at no-load for 15 minutes and examined for proper performance to ensure that rated voltage, rated frequency, and adequate oil pressure were obtained. The generator sets and trailers were visually inspected frequently for any evidence of structural damage, deformation, loosening, or breakage that might have occurred during travel.

TABLE 2.4-1. ROADABILITY TEST SCHEDULE

Road Course	Distance		Maximum Speed	
	km	mi	km/hr	mph
Paved Highway <sup>a</sup>	402	250	80	50
Level Cross-Country, Perryman No. 1	402	250	32	20
Hilly Cross-Country, Churchville B	201	125	32	20
Belgian Block	24	15	32	20
Total	1029	640	-	-

<sup>a</sup>Paved mileage between test courses was considered paved highway.

c. Electrical Performance. To detect electrical performance degradation, a short-term frequency and voltage performance test (MIL-STD-705C, Test Method 608.1b) was conducted before the start and at the end of each roadability cycle of Table 2.4-1. These tests were performed at rated load only with stabilization requirements documented.

#### 2.4.4 Test Findings

##### a. Road Test of PPs.

(1) The road test was conducted on two AN/MJQ-43 PPs (3-7/10 and 3-8/9). The AN/MJQ-43 PPs are two 3-kW generators mounted on a M116A3 trailer. The PPs were then towed by a HMMWV on the specified test courses.

(2) The PPs did not show any undesirable roadability characteristics or instability. There was no interference between the TQG trailers and the tow vehicles.

(3) One operational problem was encountered during this test (none to sets No. 3-8, 3-9, and 3-10). This problem was as follows:

Set No. 3-7. While performing an operational check at 1228 road miles, the hour meter was noted inoperative. The K12 relay and socket were replaced and the hour meter was operational.

(4) Electrical performance data are presented in Appendix B, Tables B-2.2-13 through B-2.2-20.

##### b. Road Test of Skid-Mounted Sets.

(1) The road test was conducted on sets No. 3-1 and 3-6. One set was mounted in the bed of a High-Mobility Multipurpose Wheeled Vehicle (HMMWV) truck. The sets were secured on the HMMWV with tie-down straps. No other payload was used with this configuration.



(2) No test incidents occurred during the Road Transportability test.

(3) Electrical performance data are presented in Appendix B, Tables B-2.2-1, B-2.2-2, B-2.2-11, and B-2.2-12.

#### 2.4.5 Technical Analysis

a. The inoperable hour meter did not prevent the set from producing power; however, the hour meter is used by the soldier to keep track of when to perform maintenance on the generator sets. Procedures for troubleshooting hour-meter problems should be included in the set manuals.

b. There was no degradation of the generator's electrical performance during road testing.

c. The sets met the criteria in paragraph 2.4.2.

## 2.5 STATIC LIFT

### 2.5.1 Objective

The objective of this test was to determine if the TQG PPs were capable of being transported externally by simulating helicopter transport.

### 2.5.2 Criteria

a. Air Transportability. The set shall not be damaged (para 6.3.10 and 6.3.17) by aircraft and helicopter transportation (para 6.3.13), and shall be transportable while facing forward, aft and to either side (PD, para 3.13.3).

b. Damage. Damage is defined as any failure (para 6.3.14), rough handling damage (para 6.3.10) or degradation in life. The blowing (opening) of a replaceable fuse is not considered damage, provided it is performing its intended function (PD, para 6.3.17).

c. Rough Handling Damage. Rough handling damage is defined as any condition resulting in malfunctioning of the set, liquid leakage, deformation, loosening, breakage, or change of fit of any component or part (PD, para 6.3.10).

d. Aircraft and Helicopter Transportation. Aircraft and helicopter transportation shall be interpreted to mean a 9-inch end-drop under test conditions specified in MIL-STD-705, TM 740.3 (PD, para 6.3.13).

e. The following requirements shall apply to all static testing (MIL-STD-913A, para 5.1, 5.1a, and 5.1c) (ref 10):

(1) The item shall maintain stability while suspended in the rigged configuration.

(2) The sling legs shall meet the clearance requirements of paragraph 4.2.2. Structural members that contact a sling leg in the rigged configuration must be proof load tested, in accordance with paragraph 5.2.

### 2.5.3 Test Procedures

a. General. The Static Lift test was conducted on PPs No. 3-7 and 3-10.

b. Static Lift Tests.

(1) The PP trailer was placed in single-point suspension. The two stabilizer legs stowed at the front wall of the trailer were lowered. (This configuration is appropriate for helicopter transport. It prevents the trailer from upsetting during hook-up and release operations.) The jack stand for the trailer was pivoted to its stowed position and secured. A four-legged 10K sling

set was positioned with its inner legs routed to the lunette end of the trailer and the outer legs to the tailgate end. The apex of the sling set was attached to the hook of a mobile crane and carefully hoisted off the ground. Load stability and attitude were checked and sling adjustments were made as necessary to achieve a desired attitude of 1 to 5° down at the end facing forward. Photographs of the static lifts appear in Appendix B, Figures B-2.5-1 and B-2.5-2.

(2) Proof load testing of the lift provisions of these trailers was not attempted during this test since the lift provisions of this model trailer were deemed satisfactory during previous testing.

#### 2.5.4 Test Findings

Results of the Static Lift test on the PPs appear in Table 2.5-1.

TABLE 2.5-1. PP STATIC LIFT RESULTS

Suspension	Link Count		Load Attitude	Remarks
	Front	Rear	Trailer Rear Down, deg	
Single-point 10K sling set	7	3	1.0	Chains lightly contacted the generator housing at trailer rear and curbside at lunette end.
	15	3	3.3	All chains lightly contacted generator housing.
	20	3	4.5	

Note: The static lift data and photographs were provided to the Natick Soldier System Center, as required, for flight certification assessment.

#### 2.5.5 Technical Analysis

Static lift testing indicated that the chains lightly contacted the generator housing. Shielding materials could be affixed to the sling chains where they contacted the generator housing to minimize abrasive wear. The trailers are considered stable and posed no significant interference problems with slings rigged in single-point suspension.

## 2.6 HIGH-ALTITUDE ELECTROMAGNETIC PULSE (HAEMP) ENVIRONMENT

### 2.6.1 Objective

The objective of this test was to determine if the HAEMP pulse affected the TQG sets.

### 2.6.2 Criteria

a. The set shall withstand the HAEMP nuclear environment specified in Appendix C in both operating and non-operating conditions. The set shall meet operational requirements specified herein within 5 minutes (recover) after being subjected to the specified HAEMP nuclear environment. The recovery may include manual or automatic correction of HAEMP inducted changes in the set, to include restart, but not the replacement of pieceparts or components. The cables to the load shall be 100 feet in length and sets and other equipment shall be configured for worst-case system response during the exposure (PD, para 3.5).

b. ... For the purposes of nuclear survivability testing, Contractor-Furnished-Equipment (CFE) shall include the sets, kits, and any optional equipment furnished by the contractor to the Government under terms of the contract. The set shall be placed within a ground-effect electromagnetic pulse facility in the worst case orientation. The set or sets shall be exposed to the EMP environments specified in Appendix C. The sets shall meet the requirements of 3.5 immediately after exposure... (PD, para 4.7.11).

c. The sets shall operate as specified in section 3 of this PD after being subjected to the applicable nuclear environments specified... Sets shall be subjected to the applicable nuclear environments specified in MIL-STD-2160, High-Altitude Electromagnetic Pulse (HAEMP) Environment (ref 11), during testing. Specified area of testing is electromagnetic pulse (PD, app C, page 77).

### 2.6.3 Test Procedures

a. General. The HAEMP test was conducted on PPs 3-8 and 3-9. The test was conducted at the Horizontally Polarized Dipole (HPD) Electromagnetic Pulse (EMP) Simulator located at the Naval Air Warfare Center Aircraft Division, Patuxent River, Maryland.

b. The HAEMP test was conducted using the following procedures:

(1) The PP was placed in parallel orientation to the HPD antenna. The load bank cables were connected and the sets were started to ensure proper operation.

(2) The sets were not operating when they were subjected to a pulse at 50 percent of the required test level. The generator sets were then started and rated load was applied to verify proper operation.

(3) The generator set continued to operate at rated load, and a pulse at 50 percent of the required test level was applied. The nonoperating set was then started and rated load was applied to verify proper operation.

(4) The generator set continued to operate at rated load, and a pulse at 100 percent of the required test level was applied. The nonoperating set was then started and rated load was applied to verify proper operation.

(5) The PP was placed perpendicular to the HPD antenna and the sets were started to ensure proper operation.

(6) The steps in paragraphs 2.6.3b(2) through (4) were repeated.

#### 2.6.4 Test Findings

- a. The sets operated properly when subjected to the specified pulse.
- b. The HAEMP test data are available upon request from the Support Equipment Team, ATC (with approval of the test sponsor).

#### 2.6.5 Technical Analysis

The HAEMP environment did not operationally affect the sets.

# SECTION 3. APPENDIXES

## APPENDIX A. TEST CRITERIA

Item	Applicable Source <sup>a</sup>	Test Criteria	Subtest	Remarks
1	Para 3.2.6	The set shall be designed in accordance with criteria of design for Human Factors Engineering as described in MIL-STD-1472E. The set shall be transportable, operable and maintainable during day and night by 5th percentile through 95th percentile soldiers when wearing the clothing which is appropriate to the environments described in paragraph 3.6 and 3.8.1, including Arctic and MOPP IV clothing and mittens. Particular design attention shall be given, but not limited to the following paragraphs of MIL-STD-1472E: 4 (General Requirements), paragraph 5.1 (Control/Display Integration), 5.2 (Visual Display), 5.3 (Audio Display), 5.4 (Controls), 5.5 (Labeling), 5.6 (Anthropometry), 5.9 (Design for Maintainability), and 5.13 (Hazards and Safety). Specific citations of MIL-STD-1472 contained elsewhere in this Purchase Description shall not preclude this general requirement.	2.1	
2	ROC, para 5b	CGSAs in all operating configurations must: ... Be man portable (4-man) for the 3 kW skid mounted set; ...	2.1	Met.

<sup>a</sup>Unless otherwise specified, the criteria were taken from Purchase Description, Generator Sets, Diesel-Fueled, Skid-Mounted, Lightweight, Tactical, Quiet, 3-kW, updated through P00011, 6 March 1998.

Note: PD, paragraphs 3.6 and 3.8.1 refer to starting and operating the generators when personnel are outfitted in nuclear, biological, and chemical (NBC) or mission-oriented protective posture (MOPP) IV clothing without special tools.

Item	Applicable Source <sup>a</sup>	Test Criteria	Subtest	Remarks
3	Para 3.7	Electrical Performance. Set electrical performance shall be as specified herein. Set rating shall be 3.0 kW at 4000 feet altitude and 95 °F. If the operational weight of the set with the battery removed is 326 pounds or less, a set rating of 3.0 kW at 1000 feet altitude and 107 °F is acceptable (3.0 kW at 4000 feet and 95 °F is still preferred). Components of the set shall not be damaged (para 6.3.17) when the set is operated continuously at all possible frequency and voltage adjustments. The set shall provide the applicable load rating (para 3.8.2) at the output terminal under all operating conditions specified herein.	2.2	Met.
4	Para 3.33.1	Frequency Regulation. The frequency regulation (para 6.3.23) from no-load to rated load and from rated load to no-load shall be not more than 3.00 percent.	2.2	Met.
5	Para 3.33.2	Frequency Short-Term Steady-State Stability (30 seconds). At every constant load from no-load to rated load, the system shall maintain frequency within a bandwidth equal to 4.00 percent of rated frequency. The system shall not permit repetitive frequency variations, even though within the allowable 4.00 percent band.	2.2	Met.

<sup>a</sup>Unless otherwise specified, the criteria were taken from Purchase Description, Generator Sets, Diesel-Fueled, Skid-Mounted, Lightweight, Tactical, Quiet, 3-kW, updated through P00011, 6 March 1998.

Item	Applicable Source <sup>a</sup>	Test Criteria	Subtest	Remarks
6	Para 3.33.5	Frequency Transient Performance. Following any sudden increase in load, including from no-load to rated load, the governing system, if applicable, shall reestablish stable engine operating conditions within 4.00 second and the maximum transient frequency change below the new steady-state frequency (undershoot, para 6.3.24) shall be not more than 4.00 percent of rated frequency. Following any sudden decrease in load, including from rated load to no-load, the governing system shall re-establish stable engine operating conditions within 6.00 seconds, the maximum transient frequency change above the new steady-state frequency (overshoot) shall be not more than 5.00 percent of rated frequency (para 6.3.24).	2.2	Met.
7	Para 3.34.14.1	Voltage Regulation. The voltage regulation (para 6.3.23) from no-load to rated load and from rated load to no-load shall be not more than 4.00 percent of the rated voltage for all voltage connections throughout the voltage ranges specified.	2.2	Met.
8	Para 3.34.14.2	Voltage Short-Term Stability (30 seconds). At every constant load from no-load to rated load, the voltage at the set terminals shall remain within a bandwidth equal to 2.00 percent of rated voltage.	2.2	Met.

<sup>a</sup>Unless otherwise specified, the criteria were taken from Purchase Description, Generator Sets, Diesel-Fueled, Skid-Mounted, Lightweight, Tactical, Quiet, 3-kW, updated through P00011, 6 March 1998.



Item	Applicable Source <sup>a</sup>	Test Criteria	Subtest	Remarks
9	Para 3.34.14.5	Voltage Dip and Rise. Performance of the set under transient conditions, including from no load to rated load ( <u>as measured by a magnetic oscillograph</u> ) shall be as follows: With the set initially operating at rated frequency and rated voltage, and following any sudden change in load from no-load to rated load, the instantaneous voltage shall not dip (para 6.3.22) more than 30.00 percent of rated voltage and shall recover (para 6.3.19) within 3.00 seconds. Overshoot or undershoot of the final voltage shall not exceed the initial voltage transient in amplitudes. The above requirements shall also apply when the load is suddenly changed from rated load to no-load, except that the initial voltage transient shall involve a voltage rise (para 6.3.22) not to exceed 30.00 percent of rated voltage.	2.2	Met.
10	Para 3.13.2	Rail Tie-Down Procedures. A procedure for mounting of the set to a rail flat car for rail shipment (transportation) shall be provided. Mounting of the sets shall be in accordance with	2.3	

<sup>a</sup>Unless otherwise specified, the criteria were taken from Purchase Description, Generator Sets, Diesel-Fueled, Skid-Mounted, Lightweight, Tactical, Quiet, 3-kW, updated through P00011, 6 March 1998.

Note: Underlined portion was not performed. The Advanced On-Board Computer System (ADOCS) was the primary recording equipment.

Item	Applicable Source <sup>a</sup>	Test Criteria	Subtest	Remarks
		standard loading and bracing methods as shown in section 6 of the Association of American Railroads (AAR), Standard Rules Governing the Loading of Department of Defense Material on Open Top Cars.		
11	Para 3.13.4	Rail Transport. The set while facing forward, aft and to either side and the power plant assembly (para 3.19.4.2) while facing forward and aft shall be capable of being rail transported (para 6.3.11) on wood-decked, open top railcars without damage (para 6.3.10 and 6.3.17).	2.3	
12	Para 6.3.17	Damage. Damage is defined as any failure (para 6.3.14), rough handling damage (para 6.3.10) or degradation in life. The blowing (opening) of a replaceable fuse is not considered damage, provided it is performing its intended function.	2.3	Met.
13	Para 6.3.10	Rough Handling Damage. Rough handling damage is defined as any condition resulting in malfunctioning of the set, liquid leakage, deformation, loosening, breakage, or change of fit of any component or part.	2.3	Not met.
14	Para 6.3.11	Railroad Transportation. Railroad transportation shall be interpreted to mean impact speeds up to and including 8 mph under test conditions specified in paragraph 4.7.4 and Appendix D.	2.3	

<sup>a</sup>Unless otherwise specified, the criteria were taken from Purchase Description, Generator Sets, Diesel-Fueled, Skid-Mounted, Lightweight, Tactical, Quiet, 3-kW, updated through P00011, 6 March 1998.

Item	Applicable Source <sup>a</sup>	Test Criteria	Subtest	Remarks
15	Para 3.13.5	Utility Vehicle and Trailer Transport. The set shall be capable of being transported by utility vehicle or trailer transportation (para 6.3.12) while facing forward, aft, or to either side without damage (para 6.3.10 and 6.3.17).	2.4	Met.
16	Para 6.3.10	Rough Handling Damage. Rough handling damage is defined as any condition resulting in malfunctioning of the set, liquid leakage, deformation, loosening, breakage, or change of fit of any component or part.	2.4, 2.5	Met.
17	Para 6.3.17	Damage. Damage is defined as any failure (para 6.3.14), rough handling damage (para 6.3.10) or degradation in life. The blowing (opening) of a replaceable fuse is not considered damage, provided it is performing its intended function.	2.4, 2.5	Met.
18	Para 3.13.3	Air Transportability. The set shall not be damaged (para 6.3.10 and 6.3.17) by aircraft and helicopter transportation (para 6.3.13), and shall be transportable while facing forward, aft and to either side.	2.5	
19	Para 6.3.13	Aircraft and Helicopter Transportation. Aircraft and helicopter transportation shall be interpreted to mean a 9-inch end-drop under test conditions specified in MIL-STD-705, TM 740.3.	2.5	

<sup>a</sup>Unless otherwise specified, the criteria were taken from Purchase Description, Generator Sets, Diesel-Fueled, Skid-Mounted, Lightweight, Tactical, Quiet, 3-kW, updated through P00011, 6 March 1998.

Item	Applicable Source <sup>a</sup>	Test Criteria	Subtest	Remarks
20	MIL-STD-913, para 5.1, 5.1a and 5.1c	<p>The following requirements shall apply to all static testing:</p> <p>(1) The item shall maintain stability while suspended in the rigged configuration.</p> <p>(2) The sling legs shall meet the clearance requirements of paragraph 4.2.2. Structural members that contact a sling leg in the rigged configuration must be proof load tested, in accordance with paragraph 5.2.</p>	2.5	
21	Para 3.5	<p>The set shall withstand the HAEMP nuclear environment specified in Appendix C in both operating and non-operating conditions. The set shall meet operational requirements specified herein within 5 minutes (recover) after being subjected to the specified HAEMP nuclear environment. The recovery may include manual or automatic correction of HAEMP induced changes in the set, to include restart, but not the replacement of pieceparts or components. The cables to the load shall be 100 feet in length and sets and other equipment shall be configured for worst-case system response during the exposure.</p>	2.6	Met.

<sup>a</sup>Unless otherwise specified, the criteria were taken from Purchase Description, Generator Sets, Diesel-Fueled, Skid-Mounted, Lightweight, Tactical, Quiet, 3-kW, updated through P00011, 6 March 1998.

Item	Applicable Source <sup>a</sup>	Test Criteria	Subtest	Remarks
22	Para 4.7.11	... For the purposes of nuclear survivability testing, Contractor-Furnished-Equipment (CFE) shall include the sets, kits, and any optional equipment furnished by the contractor to the Government under terms of the contract. The set shall be placed within a ground-effect electromagnetic pulse facility in the worst case orientation. The set or sets shall be exposed to the EMP environments specified in Appendix C. The sets shall meet the requirements of 3.5 immediately after exposure...	2.6	Met.
23	Appendix C, page 77	The sets shall operate as specified in section 3 of this PD after being subjected to the applicable nuclear environments specified... Sets shall be subjected to the applicable nuclear environments specified in MIL-STD-2160, High-Altitude Electromagnetic Pulse (HAEMP) Environment, during testing. Specified area of testing is electromagnetic pulse.	2.6	Met.

<sup>a</sup>Unless otherwise specified, the criteria were taken from Purchase Description, Generator Sets, Diesel-Fueled, Skid-Mounted, Lightweight, Tactical, Quiet, 3-kW, updated through P00011, 6 March 1998.

## APPENDIX B. TEST DATA

TABLE B-2.1-1. HFE QUESTIONNAIRES AND CHECKLISTS

How would you rate the adequacy of the following?									
Rating Scale									
6 Excellent 5 Very Good 4 Adequate 3 Not Quite Adequate 2 Poor 1 Extremely Poor									
Human Factors Engineering - Adequacy									
	6	5	4	3	2	1	NA	$\chi$	$\sigma$
1. Before, during, and after operation checklist.		2	1				2	4.7	0.58
2. Display panels.	1	1	3					4.6	0.89
3. Space provided to service generator.			1	3	1			3.0	0.71
4. Accessibility of hand controls.	1	3	1					3.8	1.30
5. Illumination of instruments during night operation.		1	1	2			1	3.4	1.14
6. Protection of operator from moving parts by guards and warning labels.		5						5.0	0.0
7. Lifting provisions.		4	1					4.8	0.45
8. Access for using test equipment.		3	2					4.6	0.55
9. Standard tools and test equipment.		1	2	1	1			3.6	1.14
10. Technical manuals for operations and maintenance.		4						5.0	0.0
11. Based upon the previous questions, rate the OVERALL ADEQUACY of the generator.		3	2					4.6	0.55

TABLE B-2.1-1 (CONT'D)

How would you rate the adequacy of the following?									
Rating Scale									
6 Excellent 5 Very Good 4 Adequate 3 Not Quite Adequate 2 Poor 1 Extremely Poor									
Human Factors Engineering - Adequacy									
	6	5	4	3	2	1	NA	$\chi$	$\sigma$
1. Reading warnings or instruction labels.	1	4						5.2	0.45
2. Connecting and disconnecting power cables.	1	2		1	1			4.2	1.64
3. Operation and maintenance while wearing arctic clothing.			1	4				3.2	0.45
4. Operation and maintenance while wearing NBC clothing.		1	2	2				3.8	0.84
5. Reading and understanding the materials presented in the Technical Manuals.		4					1	5.0	0.0
6. Setup for operation.	1	2	1				1	5.0	0.82
7. Operation during hours of darkness.	1	4						5.2	0.45
8. Based upon previous questions, rate the OVERALL EASE OF OPERATION.		4	1					4.8	0.45



TABLE B-2.1-1 (CONT'D)

How would you rate the adequacy of the following?

## Rating Scale

- 6 Excellent  
 5 Very Good  
 4 Adequate  
 3 Not Quite Adequate  
 2 Poor  
 1 Extremely Poor

## Human Factors Engineering - Adequacy

	6	5	4	3	2	1	NA	$\chi$	$\sigma$
1. The vibration level during operations.			3	1				3.8	0.50
2. The noise level during operation.		2	2					4.5	0.58
3. Exhaust fumes during operation.		2	2					4.5	0.58

## Human Factors Engineering - Frequency

	6	5	4	3	2	1	NA	$\chi$	$\sigma$
1. Requirement for special tools and test equipment.		2	1	1				4.3	0.96
2.. Glare on operating instruments and gauges.		3		1				4.5	1.00

TABLE B-2.1-2. HFE - DESIGN - CONTROLS, DISPLAYS, AND MARKINGS

ITEMS	YES	NO	NA	COMMENTS
1. Controls.				
a. Are all adjustments located on a single panel?	Yes			
b. Are controls placed on the panel in the order they will normally be used?	Yes			
c. When controls are used in a fixed procedure, are they numbered to indicate?			NA	
d. Are controls labeled with functional statements?	Yes			
e. Are control-position markings descriptive rather than coded or numbered?	Yes			
f. Are control scales fine enough to permit accurate setting?	Yes			
g. Except for detents or selector switches, do the controls have smooth, even resistance to movements?	Yes			The voltage knob vibrates loose. The test participants said it would be nice to have the old knobs that set and lock.
h. Are concentric knobs adequately coded to avoid confusion?	Yes			
i. Are adjustment controls easy to set and lock?		No		The voltage knob does not set and lock.
j. Do all physical adjustment procedures provided visual, auditory, or tactical feedback?	Yes			
k. Are controls free of excessive backlash that could require needless readjustment?	Yes			

TABLE B-2.1-2 (CONT'D)

ITEMS	YES	NO	NA	COMMENTS
1. Are primary and emergency controls identifiable both visually and nonvisually?	Yes			
m. Can controls be operated by personnel wearing arctic and NBC clothing?	Yes			
n. The method used to prevent accidental activation of the control, if any, does not increase the time required to operate the control to such an extent that it is unacceptable.	Yes			
2. Displays.				
a. When this equipment is placed in ways that it will typically be used, can the display be easily read?	Yes			
b. The information presented is necessary for the decisions or actions required of the operator.	Yes			
c. The information is presented in the most immediately meaningful form, i.e., no interpretation or decoding is required.	Yes			
d. The information is displayed to the accuracy required by the decisions or actions of the operator.	Yes			
e. Are display scales limited to only that information needed to make decisions or to take some action?	Yes			

TABLE B-2.1-2 (CONT'D)

ITEMS	YES	NO	NA	COMMENTS
f. Information is current, that is, lag is minimized.	Yes			It is difficult to differentiate between the colors of the load wires when they are dirty, which is to be expected.
g. Failure is clearly shown or the operator is otherwise warned.	Yes			
h. The contrast ratio and illumination of controls and/or displays are sufficient under all expected light conditions.	Yes			
i. A warning device is provided to indicate significant deviations from normal operating conditions.	Yes			
3. Miscellaneous.				
a. Vibration and noise are kept below levels that might impair the efficiency of personnel.	Yes			
b. Visibility provides the maximum field-of-view possible in consonance with station, task requirement, and body conformation.	Yes			
c. Illumination of controls and displays is sufficient for the operators to carry out necessary tasks.	Yes			
d. Vibrations do not affect operator performance in reading dials and manipulating controls.	Yes			
e. No material within the operator's vision is capable of impairing vision during day or night operation.	Yes			

TABLE B-2.1-3. HFE CHECKLIST - MAINTAINABILITY

ITEMS	YES	NO	NA	COMMENTS
1. Handles.				
a. When possible, handles are provided on covers, drawers, and components to facilitate handling.	Yes			
b. When handles cannot be provided, hoist and lift points are clearly marked.	Yes			
2. Covers.				
a. Methods of opening a cover is evident from the construction of the cover itself. If not, an instruction plate is permanently attached to the outside of the cover.	Yes			
b. Hinges are used where possible to reduce the number of fasteners required.	Yes			
c. When a hinged cover is used, a space equal to the swept volume of the cover is provided (e.g., opening of the cover is not obstructed by bulkheads, brackets, etc.).	Yes			
d. Structural members, other components, etc., do not interfere with removal of a cover.		No		Have to disconnect fan to take cover off.
e. Is it evident when the cover is in place but not secured?	Yes			
f. If instructions applying to a covered unit are lettered on a hinged door, the lettering is properly oriented for reading when the door is open.	Yes			

TABLE B-2.1-3 (CONT'D)

ITEMS	YES	NO	NA	COMMENTS
g. A minimum number and type of fasteners are used, commensurate with requirements for stress, bonding, etc.	Yes			
h. When possible, the same size and type of fasteners are used for all covers, cases, and access doors.	Yes			
i. Captive nuts and bolts are used where feasible.		No		The cover, the body control panel.
3. Location of Replaceable Components.				
a. Large components which are difficult to remove are mounted so that they do not prevent access to other components.		No		The muffler is in the way when taking the starter off.
b. Components are placed to allow sufficient space for use of test equipment and other required tools without difficulty or hazard.	Yes			
c. All throwaway components are accessible without removal of other components.	Yes			
d. Structural members of the frame do not prevent access to components.	Yes			
e. Delicate components are so located or guarded that they will not be damaged while the unit is being handled or worked on.		No		The bottom of the solenoid has broken off behind the battery.
f. Sensitive adjustments are so located or guarded that they cannot be accidentally disturbed.	Yes			

TABLE B-2.1-3 (CONTD)

ITEMS	YES	NO	NA	COMMENTS
g. Internal controls are located at a safe distance from dangerous voltages or access to dangerous voltages is prevented by suitable barriers.	Yes			
4. Conductors and Cables.				
a. Conductors are bound into cables and held by means of lacing twine or other acceptable means.	Yes			
b. Long conductors or cables, internal to equipment, are secured to the chassis by cable clamp.	Yes			
c. Cables are long enough so that each functioning component can be checked in a convenient place or, if this is not feasible, extension cables/devices are provided.	Yes			
d. Cables are long enough to permit jockeying or movement of components when it is difficult to connect or disconnect other cables.	Yes			
e. Electrical cables are not routed below fluid lines.	Yes			
f. Cables are routed so they cannot be walked on or used for handholds.	Yes			
g. Cables are easily accessible for inspection and repair.	Yes			
h. Cables are so routed that they need not be bent or twisted sharply or repeatedly.	Yes			

TABLE B-2.1-3 (CONT'D)

ITEMS	YES	NO	NA	COMMENTS
i. Input and output cables, with the exception of test cables, do not terminate on a control-display panel.	Yes			
j. If test cables terminate on control-display panels, test receptacles are located so that their associated cables do not interfere with controls and displays.	Yes			
5. Connectors.				
a. One-turn or other quick-disconnect plugs are used.	Yes			
b. When dirt and moisture are a problem, plugs have an attached cover.	Yes			
c. Connectors are located far enough apart so that they can be grasped firmly for connection and disconnection.	Yes			The connectors are far enough apart. The back AC connector is difficult to reach due to location.
d. Plugs are designed so that it is impossible to insert the wrong plug in a receptacle.		No		
e. Socket rather than plug contacts are "hot".	Yes			The connectors on the AC inverter can be inserted into the wrong plug.
f. Test points to determine that a unit is malfunctioning are provided.	Yes			
g. Appropriate test provided when a component is not completely self-checking.	Yes			



TABLE B-2.1-3 (CONT'D)

ITEMS	YES	NO	NA	COMMENTS
6. Fuses and Circuit Breakers.				
a. Fuses and circuit breakers are located so that they can be easily seen and quickly replaced or reactivated by personnel wearing clothing appropriate to environment of interest.	Yes			
b. No special tools are required for fuse replacement.	Yes			
7. Tools.				
a. Variety of tools is held to a minimum.	Yes			
b. As few special tools as possible are required.	Yes			
c. Tools to be used near high voltage are adequately insulated.			NA	
d. Metal handles are avoided on tools likely to be used in extreme cold or heat.	Yes			
8. Lubrication.				
a. Equipment containing mechanical components either has provisions for lubrication without disassembly or does not require lubrication.	Yes			
b. When lubrication is required, the type of lubrication to be used and the frequency of lubrication are specified by a label at or near the lubrication point.	Yes			

TABLE B-2.1-4. TIMED OPERATOR/MAINTAINER PERFORMANCE TASKS

Phase 1				
Timed Task	Test Participant ID/Generator ID			
	A/3-3	B/3-2	C/3-2	D/3-3
	Time, min:sec	Time, min:sec	Time, min:sec	Time, min:sec
<b>Clothing:</b>	Normal Work Clothes with Bare Hands			
	Average of three trials per test participant			
PMCS	01:15	01:20	00:35	00:53
Check/change oil	15:10	15:00	14:05	12:43
Replace air filter	00:38	00:40	00:37	00:41
Connect lead cable	04:10	02:00	02:10	01:11
Replace fuel filter	07:10	03:45	04:15	02:22
Fill fuel tank				
Battery maint	No maintenance required			
Adjust belts	No belts to adjust			
Start and operate	No problems reported or observed			
<b>Clothing:</b>	Arctic Parka/Hood/Trigger Finger Mitts			
Timed Task	A/3-3	B/3-2	C/3-2	D/3-3
	Time, min:sec	Time, min:sec	Time, min:sec	Time, min:sec
	Average of three trials per test participant			
PMCS		00:45	02:05	00:56
Check/change oil		09:20	20:18	14:25
Replace air filter		00:56	01:31	01:29
Connect lead cable		03:25	03:38	01:49
Replace fuel filter		03:00	02:54	02:22
Fill fuel tank				
Battery maintenance	No maintenance required			
Adjust belts	No belts to adjust			
Start and operate	No problems reported or observed			
<b>Clothing:</b>	Arctic Parka/Hood/Mitts			
Timed Task	A/3-3	B/3-2	C/3-2	D/3-3
	Time, min:sec	Time, min:sec	Time, min:sec	Time, min:sec
	Average of three trials per test participant			
PMCS	01:18	04:10	01:50	00:38
Check/change oil	24:40	11:50	17:10	17:49
Replace air filter	02:18	01:28	01:22	01:02
Connect lead cable	05:20	04:47	04:48	04:31
Replace fuel filter	06:35	04:28	05:50	03:11
Fill fuel tank				
Battery maintenance	No maintenance required			
Adjust belts	No belts to adjust			
Start and operate	No problems reported or observed			

TABLE B-2.1-4 (CONT'D)

Phase 2				
Clothing:	NBC Mask/Gloves			
Timed Task	A/3-3	B/3-4	C/3-4	E/3-3
	Time, min:sec	Time, min:sec	Time, min:sec	Time, min:sec
	Average of three trials per test participant			
PMCS	01:18	00:57	01:16	01:20
Check/change oil	10:37	14:20	13:11	08:59
Replace air filter	00:53	01:05	01:16	01:10
Connect lead cable	01:38	01:31	01:56	01:55
Replace fuel filter	03:16	02:35	02:24	01:49
Fill fuel tank				
Battery maintenance	No maintenance required			
Adjust belts	No belts to adjust			
Start and operate	No problems reported or observed			
Clothing:	Normal Work Clothes with Bare Hands at Night			
Timed Task	D/3-3	"B"/3-4	"C"/3-4	"E"/3-3
	Time, min:sec	Time, min:sec	Time, min:sec	Time, min:sec
	Average of three trials per test participant			
PMCS	01:51	01:22	01:10	00:52
Check/change oil	17:07	09:00	10:30	08:24
Replace air filter	00:42	00:38	00:47	02:28
Connect lead cable	02:40	01:40	01:47	01:41
Replace fuel filter	02:38	02:25	03:24	01:02
Fill fuel tank				
Battery maintenance	No maintenance required			
Adjust belts	No belts to adjust			
Start and operate	No problems reported or observed			

TABLE B-2.1-5. NET EVALUATION SUMMARY

(M = Mean, SD = Std Deviation, N = nbr of responses)

<b>A. INSTRUCTORS</b>		1	2	3	4	5	6	7	8	9	M	SD	N	
1. Used confusing terms	Never	4	4	1	1	3	1			1	3.27	2.34	15	Always
2. Speaking ability	Poor	1			2		2	3	5	2	6.67	2.19	15	Excellent
3. Subject knowledge	Poor	2	1		3			1	5	3	6.00	3.00	15	Excellent
4. Treatment of students	Discourteous			1	2				6	6	7.53	2.07	15	Courteous
5. Student awareness	Never	3	1	1	1	1			6	2	5.53	3.20	15	Always
6. Preparation	Poor	2	2	1	1	1	1	3	3	1	5.20	2.81	15	Excellent
7. Response to questions	Poor	2	1	1	2			2	3	4	5.93	3.08	15	Excellent
8. Overall rating	Unsatisfactory	2		2	2			1	3	5	6.13	3.09	15	Outstanding
<b>B. INSTRUCTION</b>														
1. Concepts were clear early	Never			1	4	1	1	1	4	3	6.40	2.20	15	Always
2. Concepts developed well	Never			1	4	1		2	4	3	6.47	2.20	15	Always
3. Presentation was:	Boring	2	2	1	1	2		3	3	1	5.13	2.80	15	Interesting
4. Discussions were:	Waste of time	1	1		4			3	4	2	6.00	2.59	15	Valuable
5. Material presented:	Too slowly	2	1	2	3	5	1		1		4.07	1.87	15	Too rapid
6. Material coverage was:	Too superficial	1		3	3	4	2	1	1		4.60	1.76	15	Too technical
7. Training aids were:	Poor	2	2		1	1	1	3	3	2	5.60	2.90	15	Excellent
8. Training aids were used:	Too seldom		1	1	3	5	2	1	1	1	4.87	1.51	15	Too often
9. Lectures led into PEs	Never	1	1	1	2	3	1	3	1	2	5.47	2.42	15	Always
<b>C. PRACTICAL EXERCISES (PE)</b>														
1. Time for PEs was:	Inadequate			2	2	2		3	2	4	6.47	2.26	15	Adequate
2. PEs were on Generators:	Never			1	2			1	2	9	7.67	2.16	15	Always
3. All students participated:	Never				2		1		2	9	7.93	1.86		Always
4. PEs were on schedule:	Never		1		3			2	3	6	7.07	2.37	15	Always
5. What % was hands on:	10 20 30 40 50 60 70 80 90													Always
		4	3	3	1	3		1			30 %	18.52	15	
<b>D. ASSIGNMENTS AND REFERENCES</b>														
1. Assignments necessary:	Never	4	1	3	1	3		2	1		3.93	2.71	15	Always
2. Assignments were:	Too simple	4	2		1	7		1			3.60	2.03	15	Too hard
3. Manuals/references were:	Too elementary	1	3		1	9	1				4.20	1.66	15	Too hard
4. Manuals % references designed for easy use:	Never	3	1	1	1	2	2	2	3		4.80	2.65	15	Always
<b>E. EXAMINATIONS</b>														
1. Material in exams was covered during instruction	Never	1			1	1	2	2	1	7	7.13	2.39	15	Always
2. Exams were:	Too short	1			2	9	3				4.80	1.21	15	Too long
3. Exams were:	Too simple	1		1	3	9	1				4.47	1.19	15	Too hard
4. Performance-type exams were given	Never	4		4	1	3	2			1	3.73	2.31	15	Always
5. Exams tested knowledge of material presented	Not at all	1			2	3		1	5	3	6.53	2.39	15	Completely

TABLE B-2.1-6. CONTROL/DISPLAY/LABELING ASSESSMENT

Diagram No.	Control	Measurement, mm	Requirement Min/Max., cm	Met, Y/N
5	DC Circuit Breaker			
	Width	8 mm	9.5 mm/25 mm	N
	Displacement	4 mm	2 mm/6 mm	Y
	Separation between controls	65 mm	13 mm (min)	Y
7	Battle Short Switch (Toggle)			
	Width	6 mm	3 mm/ 25 mm	Y
	Length	19 mm	13 mm/50 mm	Y
9	Ground Fault Circuit Interrupter			
	Width	12 mm	9.5 mm/25 mm	Y
	Displacement	4 mm	2 mm/6 mm	Y
13	Circuit Interrupter Switch (Toggle)			
	Width	6 mm	3 mm/ 25 mm	Y
	Length	19 mm	13 mm/50 mm	Y
	Separation between controls	25 mm	19 mm (min)	Y
14	Circuit Interrupter Indicator			
	Width	16 mm	9.5 mm/25 mm	Y
	Displacement	4 mm	2 mm/6 mm	Y
	Separation between controls	28 mm	13 mm/50 mm	Y
15	Voltage Adjust Rheostat			
	Width	23 mm	25 mm (max)	Y
	Length	26 mm	25 mm/100 mm	Y
	Separation between controls	28 - 48 mm	25 mm (min)	Y
16	Start/Run/Stop Switch (Toggle)			
	Width	6 mm	3 mm/ 25 mm	Y
	Length	19 mm	13 mm/50 mm	Y
	Separation between controls	29 - 48 mm	19 mm (min)	Y
17	Preheat (Toggle)			
	Width	6 mm	3 mm/ 25 mm	Y
	Length	19 mm	13 mm/50 mm	Y
	Separation between controls	27 - 39 mm	19 mm (min)	Y
18	Auxiliary Fuel (Toggle)			
	Width	6 mm	3 mm/ 25 mm	Y
	Length	19 mm	13 mm/50 mm	Y
	Separation between controls	35 mm	19 mm (min)	Y
19	Emergency Stop			
	Width	40 mm	19 mm (min)	Y
	Displacement	15 mm	3 mm/38 mm	Y
	Separation between controls	27 mm	13 mm/50 mm	Y

TABLE B-2.1-6 (CONT'D)

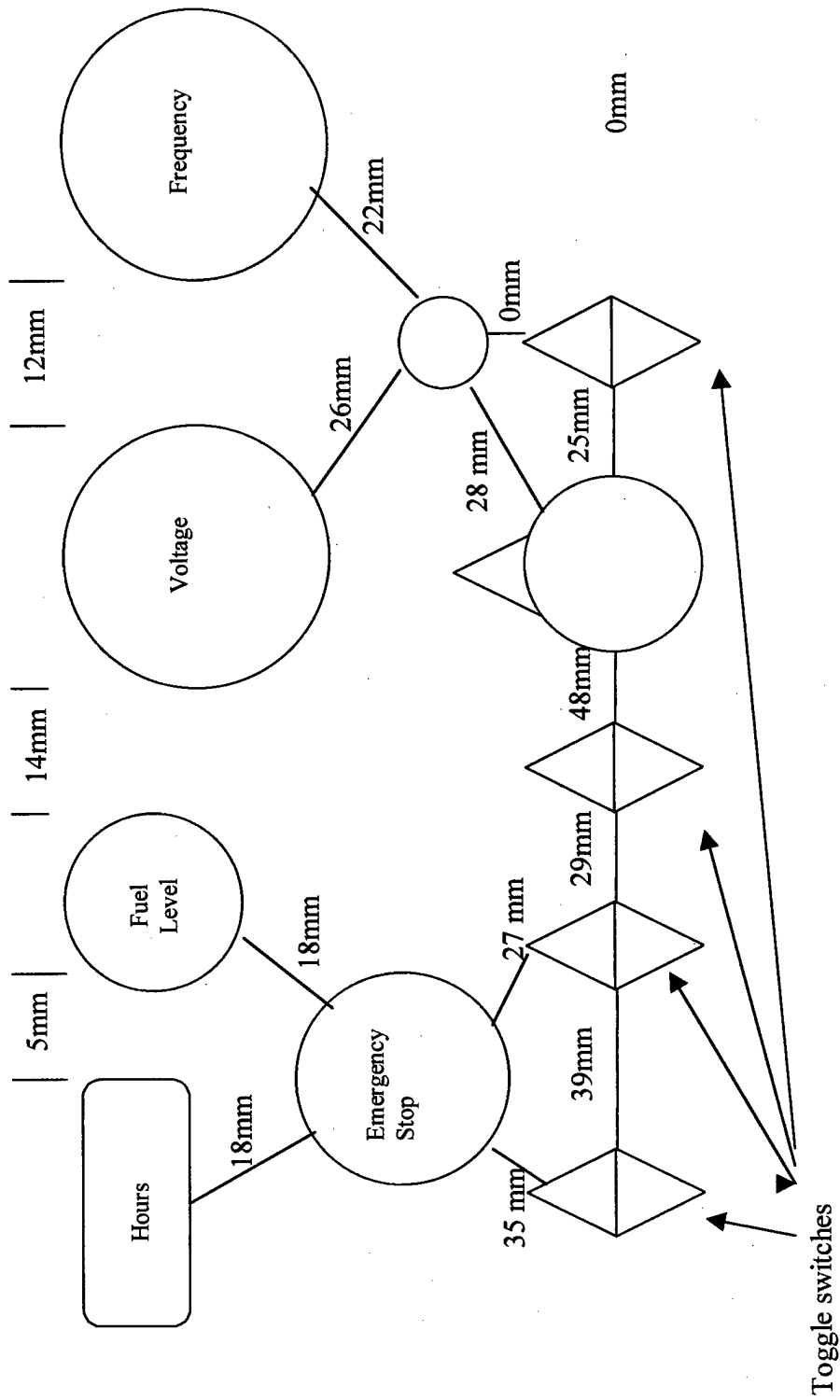


TABLE B-2.1-7. READING LEVEL AND OVERALL READING GRADE LEVEL

Operator's Manual 6115													
	Page 1-23	Page 2-19	Page 3-5	Page 4-109	Page 4-11	Page 4-22	Page 4-36	Page 4-47	Page 4-71	Page 4-83	Page B-3	Page V-txt	Average
Counts													
Words	222	203	145	157	179	147	183	124	103	88	204	191	162
Characters													
Paragraphs	4	4	10	5	5	10	11	7	8	4	3	4	6
Sentences	13	19	22	9	10	21	13	12	9	4	10	12	13
Syllables													
Averages													
Sentences per paragraph	3.2	4.7	2.2	1.8	2	2.1	1.1	1.7	1.1	1	3.3	3	
Words per sentence	17	10.6	6.5	17.4	17.9	7	14	10.3	11.4	22	20.4	15.9	14.20
Characters per word	5	5.11	5.3	4.7	5.77	5.12	5.01	4.88	5	4.7	5.89	5.68	5.18
Syllables	1.73	1.67	1.66	1.45	1.86	1.57	1.55	1.52	1.6	1.37	1.92	1.84	1.65
Readability													
Reading grade level	12	8	7	8	14	6	8	6	8	9	15	12	
Overall grade level of manual													9

Maintenance Manual 2815													
	Page 2-2	Page 3-16	Page 3-16	Page 4-15	Page 4-2	Page 4-9	Page B-3	Page V	Average				
Counts													
Words	242	201	203	214	129	102	217	209	189.6				
Characters													
Paragraphs	3	3	6	9	4	4	3	7	4.875				
Sentences	16	22	20	24	6	10	10	14	15.25				
Syllables													
Averages													
Sentences per paragraph	5.3	7.3	3.3	2.6	1.5	2.5	3.3	20	5.725				
Words per sentence	15.1	9.1	10.1	8.9	21.5	10.2	21.7	14.9	13.94				
Characters per word	4.49	4.83	4.55	5.12	5.37	4.68	5.68	5.48	5.025				
Syllables	1.41	1.59	1.45	1.59	1.79	1.4	1.84	1.75	1.603				
Readability													
Reading grade level	7	7	6	7	14	5	15	11					
Overall grade level of manual									9				

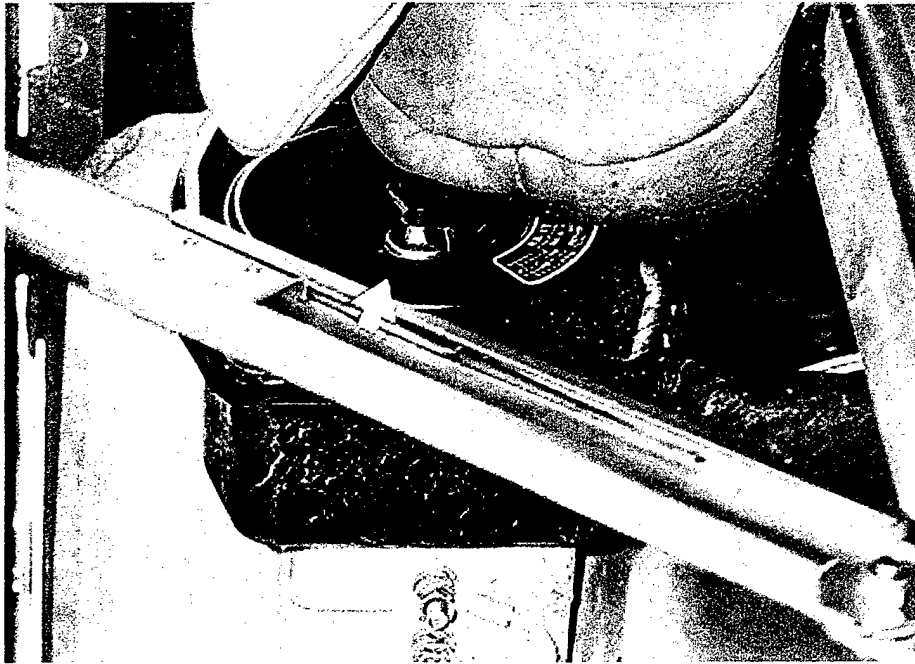


Figure B-2.1-1. Recessed small wingnut on air filter, difficult to reach with arctic mittens.

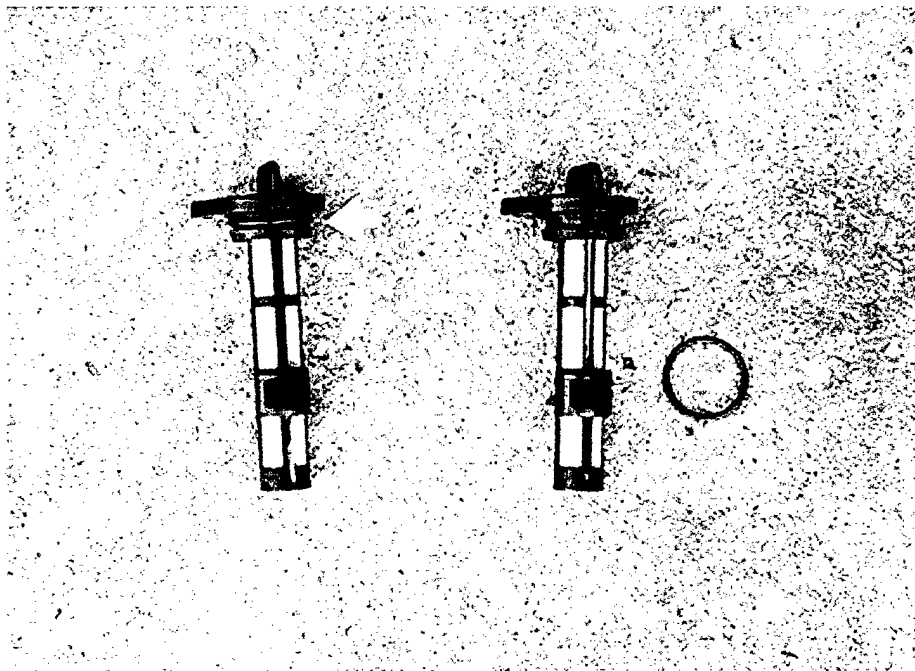


Figure B-2.1-2. Oil filters and placement of O-rings.



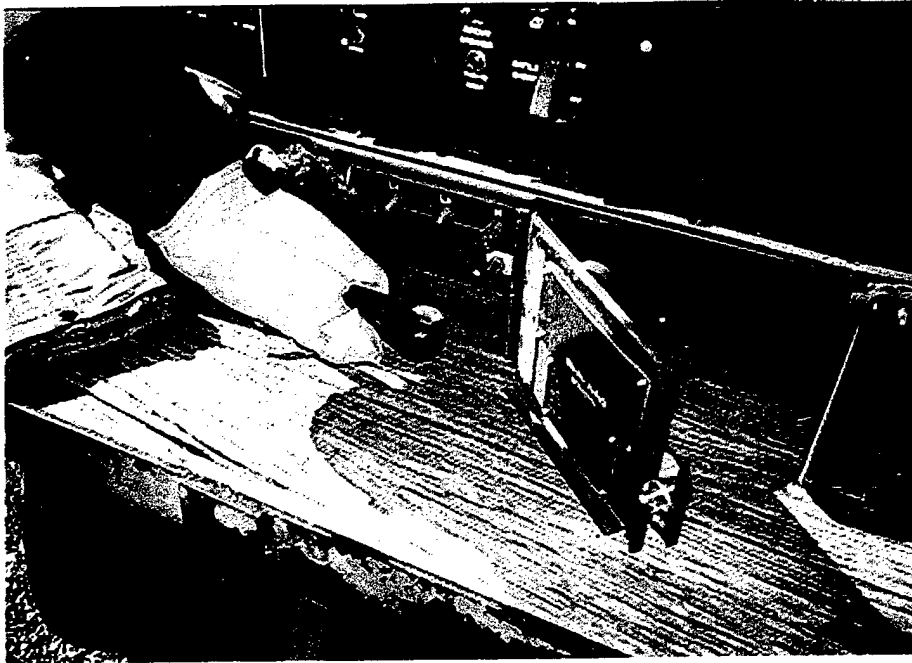


Figure B-2.1-3. Arctic mitten and load cable wrench handle.

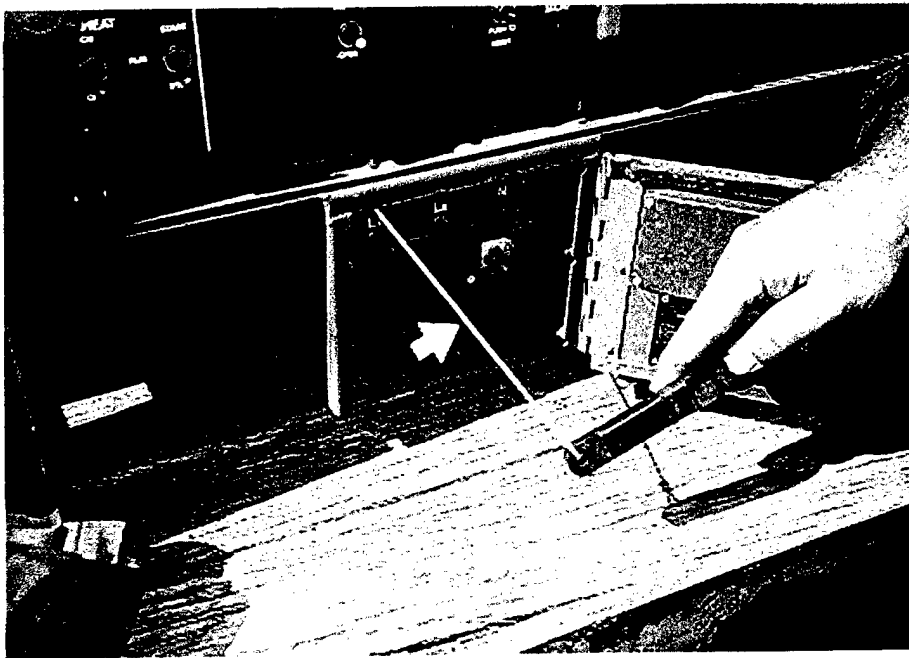


Figure B-2.1-4. Length of cord connecting load cable wrench to generator.

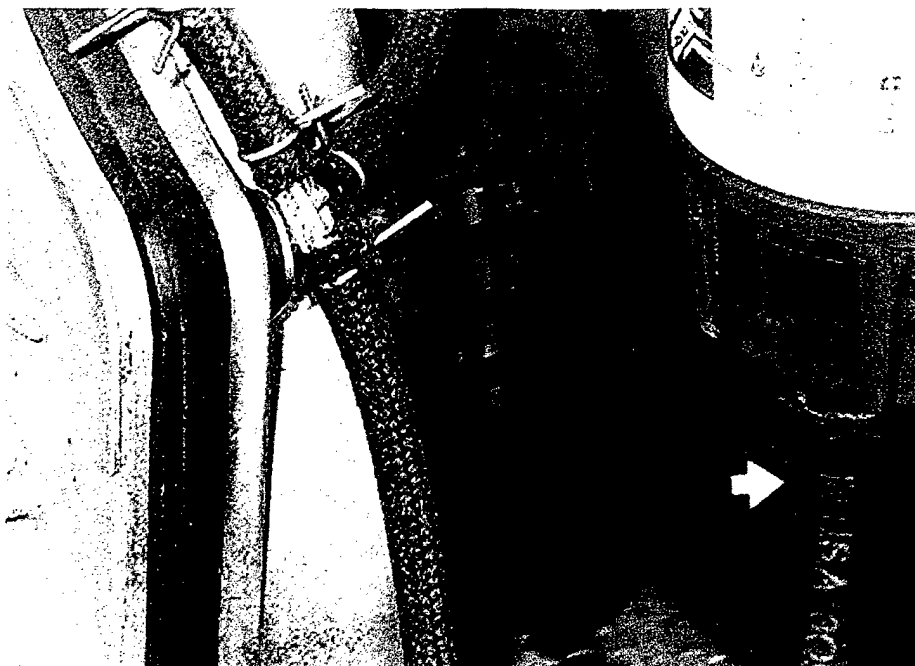


Figure B-2.1-5. Hose on the fuel filter slips off when opening fuel valve to drain.

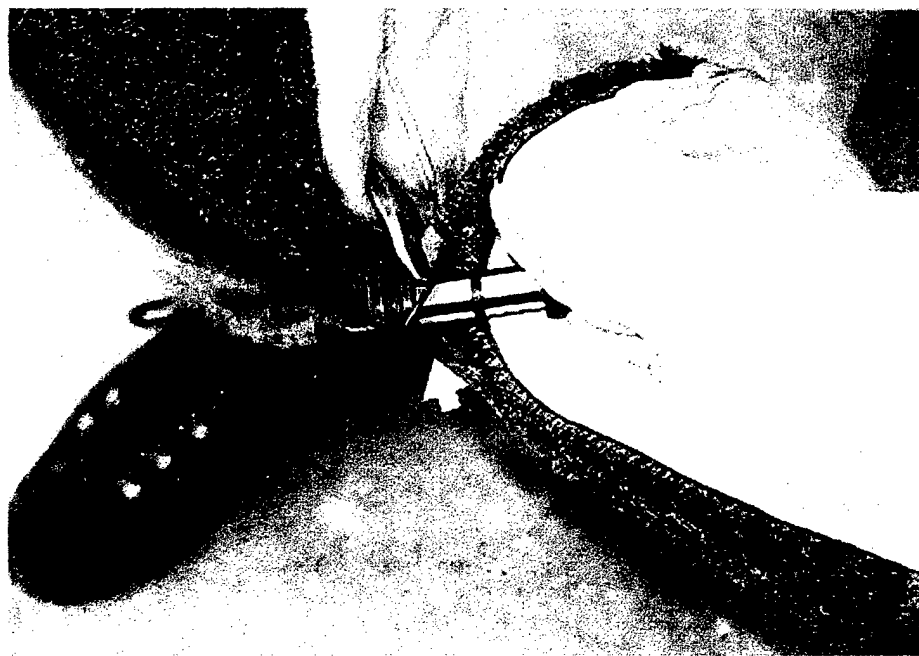
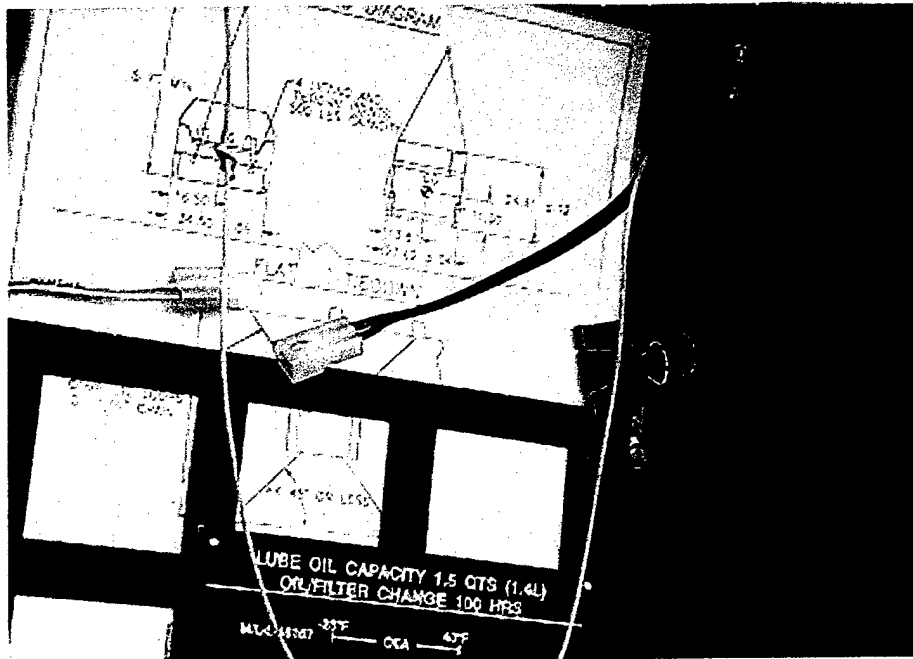


Figure B-2.1-6. Using screwdriver to remove oil filter O-ring while wearing arctic mittens.



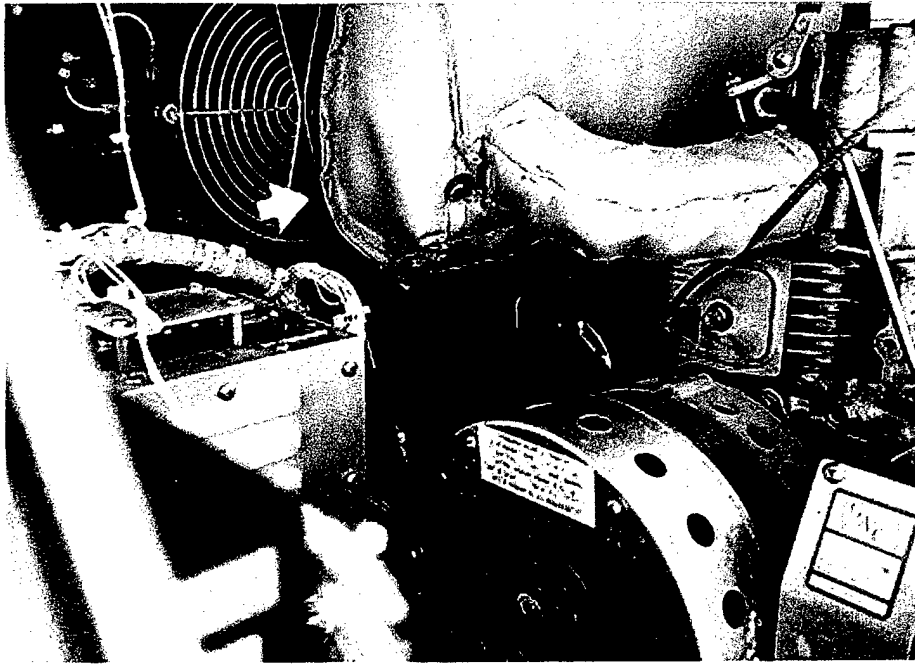


Figure B-2.1-9. Muffler in way when removing starter.

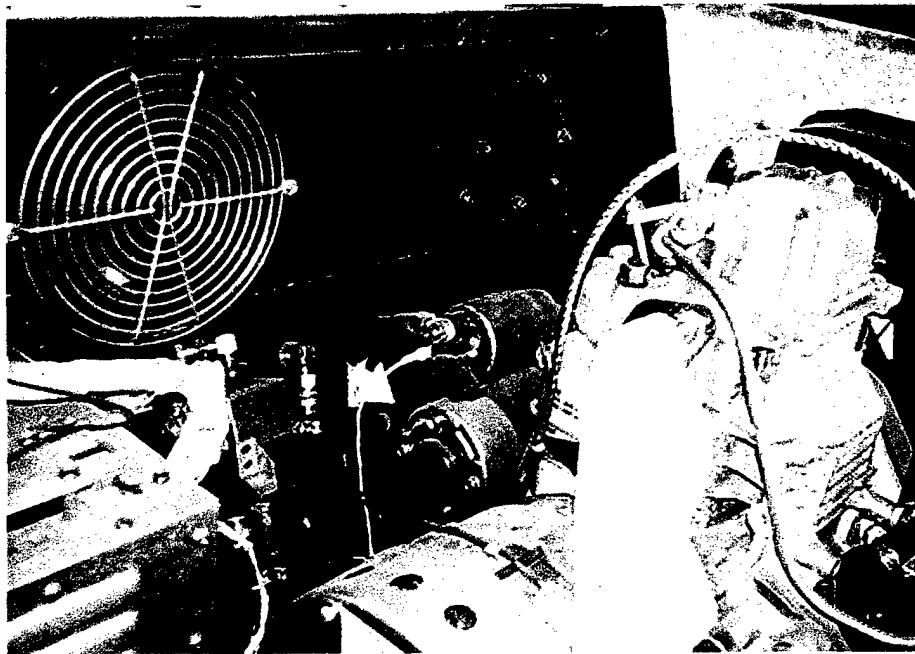


Figure B-2.1-10. Position of starter after muffler is off.

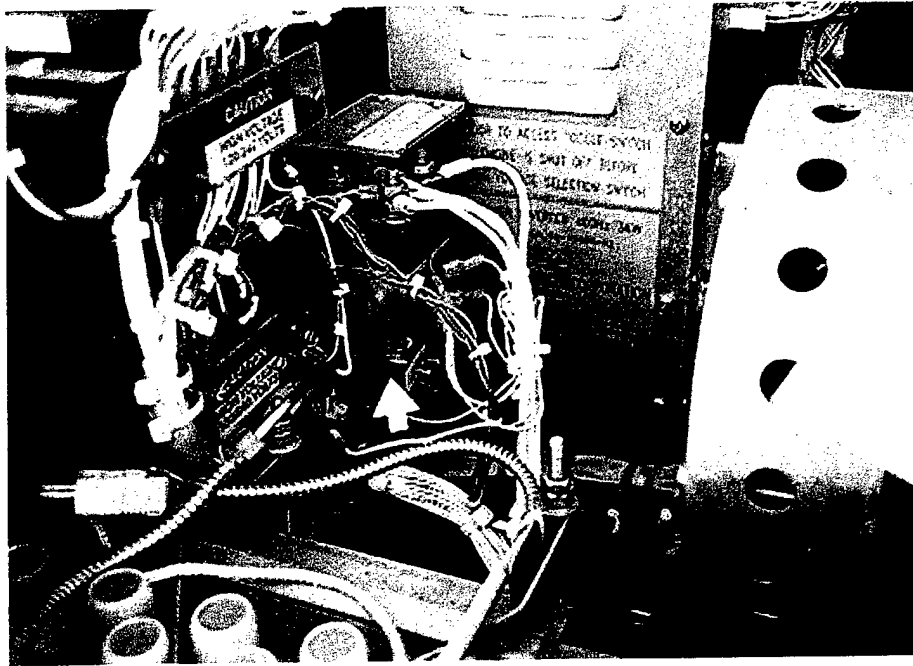


Figure B-2.1-11. Location of solenoid.

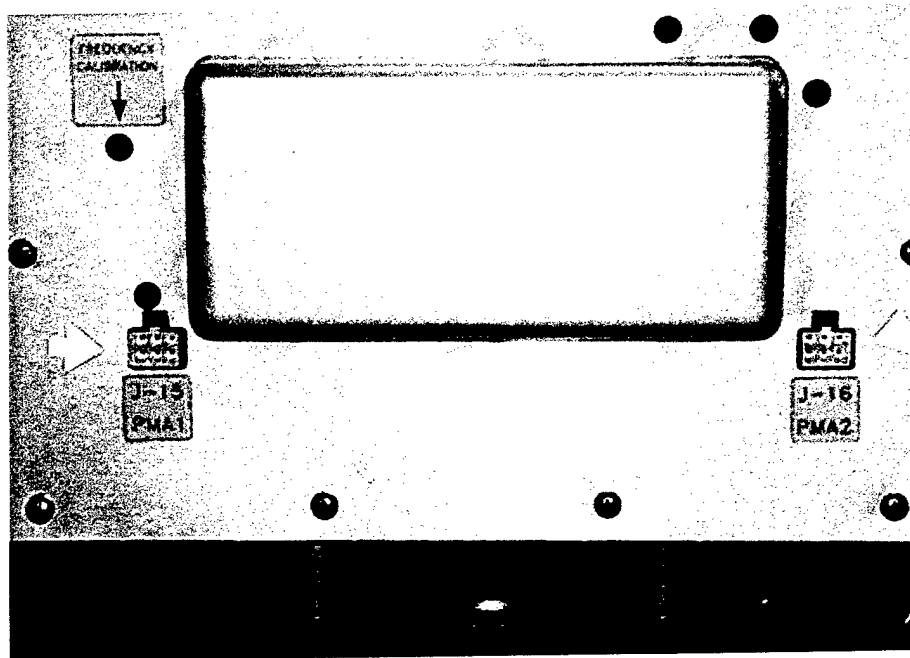


Figure B-2.1-12. Connector on the AC inverter can be inserted into wrong plug.

TABLE B-2.2-1. FREQUENCY AND VOLTAGE REGULATION, STABILITY AND TRANSIENT RESPONSE TEST FOR GENERATOR SET NO. 3-1 (VOLTAGE)

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
					[30.0]	[3.0]	[30.0]	[3.0]
Initial	62.7	100	0.1	0.2	2.7	0.1	2.3	0.1
Initial	62.7	75	0.1	0.2	1.9	0.1	1.7	0.1
Initial	62.7	50	0.1	0.3	1.2	0.1	1.2	0.1
Initial	62.7	25	0.0	0.2	1.2	0.0	0.6	0.0
Initial/Pre-Altitude	62.7	100	0.1	0.2	2.6	0.1	2.1	0.1
Altitude-1000 ft	66.8	100	0.2	0.2	2.9	0.1	2.1	0.1
Altitude-1000 ft	66.8	75	0.1	0.3	1.8	0.1	1.4	0.1
Altitude-1000 ft	66.8	50	0.1	0.2	1.3	0.1	1.3	0.1
Altitude-1000 ft	66.8	25	0.0	0.2	1.3	0.0	0.7	0.0
Altitude-1000 ft	66.8	100	0.2	0.2	2.7	0.1	2.1	0.1
Altitude-1000 ft	75.3	100	0.3	0.2	2.8	0.1	2.2	0.1
Altitude-1000 ft	75.3	75	0.1	0.3	1.6	0.1	1.5	0.1
Altitude-1000 ft	75.3	50	0.1	0.2	1.0	0.0	1.1	0.0
Altitude-1000 ft	75.3	25	0.0	0.2	2.1	0.1	0.6	0.0
Altitude-1000 ft	75.3	100	0.3	0.3	2.7	0.1	2.6	0.1
Altitude-1000 ft	84.5	100	0.2	0.2	3.0	0.1	2.1	0.1
Altitude-1000 ft	84.5	75	0.1	2.0	1.8	0.1	1.3	0.1
Altitude-1000 ft	84.5	50	0.0	0.2	1.2	0.0	1.2	0.0
Altitude-1000 ft	84.5	25	0.1	0.1	2.8	0.0	1.2	0.1
Altitude-1000 ft	84.5	100	0.2	0.1	3.0	0.1	2.1	0.1
Altitude-4000 ft	87.3	100	0.1	0.2	2.4	0.1	1.9	0.1
Altitude-4000 ft	87.3	75	0.1	0.2	1.8	0.1	1.5	0.1
Altitude-4000 ft	87.3	50	0.1	0.2	1.2	0.0	1.0	0.0
Altitude-4000 ft	87.3	25	0.1	0.2	1.8	0.1	0.6	0.0
Altitude-4000 ft	87.3	100	0.0	0.2	2.4	0.1	1.8	0.1
Altitude-8000 ft	92.7	100	0.1	0.2	1.8	0.1	1.7	0.1
Altitude-8000 ft	92.7	75	0.1	0.2	1.9	0.1	1.4	0.0
Altitude-8000 ft	92.7	50	0.0	0.2	1.3	0.0	0.9	0.0
Altitude-8000 ft	92.7	25	0.0	0.2	2.3	0.0	0.6	0.1
Altitude-8000 ft	92.7	100	0.1	0.1	1.7	0.1	1.6	0.1
Post-Actuator Mod	94.6	100	0.1	0.2	2.6	0.1	2.3	0.1
Post-Actuator Mod	94.6	75	0.1	2.0	2.1	0.1	1.7	0.1
Post-Actuator Mod	94.6	50	0.1	0.2	1.6	0.1	1.1	0.0
Post-Actuator Mod	94.6	25	0.0	0.2	2.1	0.1	0.7	0.0
Post-Act./Pre-Env	94.6	100	0.1	0.1	2.7	0.1	2.4	0.1
High Temp	98.6	100	0.2	0.2	2.9	0.1	2.5	0.1
High Temp	98.6	75	0.1	0.2	2.0	0.1	1.9	0.1
High Temp	98.6	50	0.1	0.2	1.3	0.0	1.2	0.0
High Temp	98.6	25	0.0	0.8	0.1	0.0	0.1	0.0
High Temp	98.6	100	0.2	0.1	2.9	0.1	2.5	0.1

[ ] = Purchase Description requirement.

TABLE B-2.2-1 (CONT'D)

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
			[4.0]	[2.0]	[30.0]	[3.0]	[30.0]	[3.0]
High Temp (post 608.2)	108.2	100	0.2	0.2	2.8	0.1	2.4	0.1
Pre-Voltage Drift Test	121.5	100	0.1	0.1	2.5	0.1	2.3	0.1
Low Temp 20 °F	163.0	100	0.0	0.1	2.4	0.1	2.1	0.1
Low Temp 20 °F	163.0	75	0.1	0.1	1.9	0.1	1.4	0.0
Low Temp 20 °F	163.0	50	0.1	0.1	1.5	0.1	0.9	0.0
Low Temp 20 °F	163.0	25	0.0	0.1	1.3	0.0	0.6	0.0
Low Temp 20 °F	163.0	100	0.1	0.1	2.2	0.1	2.2	0.1
Low Temp -25 °F	172.8	100	0.4	0.5	2.3	0.1	2.2	0.1
Low Temp -25 °F	172.8	75	0.6	0.5	1.5	0.1	1.3	0.1
Low Temp -25 °F	172.8	50	0.8	0.3	1.0	0.0	0.4	0.0
Low Temp -25 °F	172.8	25	0.7	0.3	0.6	0.0	0.2	0.0
Low Temp -25 °F	172.8	100	0.7	1.1	1.7	0.5	2.2	0.1
Pre-Cold Storage	181.5	100	0.1	0.2	2.8	0.1	2.4	0.1
Post-Cold Stor/Pre-Hum	183.4	100	0.2	0.2	2.7	0.1	2.5	0.1
Post-Hum/Pre-Road	184.9	100	0.0	0.2	2.0	0.1	2.6	0.1
Post-1st Road Cycle	187.9	100	0.1	0.2	2.1	0.1	2.7	0.1
Post-2nd Road Cycle	189.0	100	0.1	0.2	2.0	0.1	2.6	0.1
Post-3rd Road Cycle	190.4	100	0.1	0.2	2.1	0.1	2.6	0.1
Post-4th Road/Pre-Solar	190.4	100	0.1	0.2	2.4	0.1	2.6	0.1
Post-Solar	192.5	100	0.1	0.2	2.2	0.1	2.7	0.1

[ ] = Purchase Description requirement.

Rec = Recovery.

Tm = Time.

Trans = Transient.

TABLE B-2.2-2. FREQUENCY AND VOLTAGE REGULATION, STABILITY AND TRANSIENT RESPONSE TEST FOR GENERATOR SET NO. 3-1 (FREQUENCY)

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
			[3.0]	[4.0]	[4.0]	[4.0]	[5.0]	[6.0]
Initial	62.7	100	0.0	0.0	0.0	0.0	0.0	0.0
Initial	62.7	75	0.0	0.0	0.0	0.0	0.0	0.0
Initial	62.7	50	0.0	0.0	0.0	0.0	0.0	0.0
Initial	62.7	25	0.0	0.0	0.0	0.0	0.0	0.0
Initial/Pre-Altitude	62.7	100	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-1000 ft	66.8	100	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-1000 ft	66.8	75	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-1000 ft	66.8	50	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-1000 ft	66.8	25	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-1000 ft	66.8	100	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-1000 ft	75.3	100	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-1000 ft	75.3	75	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-1000 ft	75.3	50	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-1000 ft	75.3	25	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-1000 ft	75.3	100	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-1000 ft	84.5	100	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-1000 ft	84.5	75	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-1000 ft	84.5	50	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-1000 ft	84.5	25	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-1000 ft	84.5	100	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-4000 ft	87.3	100	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-4000 ft	87.3	75	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-4000 ft	87.3	50	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-4000 ft	87.3	25	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-4000 ft	87.3	100	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-8000 ft	92.7	100	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-8000 ft	92.7	75	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-8000 ft	92.7	50	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-8000 ft	92.7	25	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-8000 ft	92.7	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	94.6	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	94.6	75	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	94.6	50	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	94.6	25	0.0	0.0	0.0	0.0	0.0	0.0
Post-Act./Pre-Env	94.6	100	0.0	0.0	0.0	0.0	0.0	0.0
High Temp	98.6	100	0.0	0.0	0.0	0.0	0.0	0.0
High Temp	98.6	75	0.0	0.0	0.0	0.0	0.0	0.0
High Temp	98.6	50	0.0	0.0	0.0	0.0	0.0	0.0
High Temp	98.6	25	0.0	0.0	0.0	0.0	0.0	0.0
High Temp	98.6	100	0.0	0.0	0.0	0.0	0.0	0.0

[ ] = Purchase Description requirement.



TABLE B-2.2-2 (CONT'D)

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
			[3.0]	[4.0]	[4.0]	[4.0]	[5.0]	[6.0]
High Temp (post 608.2)	108.2	100	0.0	0.0	0.0	0.0	0.0	0.0
Pre-Voltage Drift Test	121.5	100	0.0	0.0	0.0	0.0	0.0	0.0
Low Temp 20 °F	163.0	100	0.0	0.0	0.0	0.0	0.0	0.0
Low Temp 20 °F	163.0	75	0.0	0.0	0.0	0.0	0.0	0.0
Low Temp 20 °F	163.0	50	0.0	0.0	0.0	0.0	0.0	0.0
Low Temp 20 °F	163.0	25	0.0	0.0	0.0	0.0	0.0	0.0
Low Temp 20 °F	163.0	100	0.0	0.0	0.0	0.0	0.0	0.0
Low Temp -25 °F	172.8	100	0.0	0.0	0.0	0.0	0.0	0.0
Low Temp -25 °F	172.8	75	0.0	0.0	0.0	0.0	0.0	0.0
Low Temp -25 °F	172.8	50	0.0	0.0	0.0	0.0	0.0	0.0
Low Temp -25 °F	172.8	25	0.0	0.0	0.0	0.0	0.0	0.0
Low Temp -25 °F	172.8	100	0.0	0.0	0.0	0.0	0.0	0.0
Pre-Cold Storage	181.5	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Cold Stor/Pre-Hum	183.4	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Hum/Pre-Road	184.9	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-1st Road Cycle	187.9	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-2nd Road Cycle	189.0	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-3rd Road Cycle	190.4	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-4th Road/Pre-Solar	190.4	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Solar	192.5	100	0.0	0.0	0.0	0.0	0.0	0.0

[ ] = Purchase Description requirement.

TABLE B-2.2-3. FREQUENCY AND VOLTAGE REGULATION, STABILITY AND TRANSIENT RESPONSE TEST FOR GENERATOR SET NO. 3-2 (VOLTAGE)

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
			[4.0]	[2.0]	[30.0]	[3.0]	[30.0]	[3.0]
Initial	75.1	100	0.1	0.6	1.9	0.1	1.5	0.1
Initial	75.1	75	0.0	0.6	1.4	0.1	1.0	0.0
Initial	75.1	50	0.1	0.2	1.2	0.0	0.8	0.0
Initial	75.1	25	0.1	0.1	0.7	0.0	0.5	0.0
Initial	75.1	100	0.1	0.7	1.9	0.1	1.4	0.1
REM 0	80.9	100	0.1	0.7	2.5	0.1	2.1	0.1
REM 0	80.9	75	0.1	0.7	2.5	0.1	1.4	0.1
REM 0	80.9	50	0.1	0.3	2.0	0.1	1.0	0.0
REM 0	80.9	25	0.1	0.1	0.0	0.0	0.1	0.0
REM 0	80.9	100	0.2	0.8	2.9	0.1	2.0	0.1
REM 100	164.8	100	0.1	0.7	2.9	0.1	1.7	0.1
REM 200	265.3	100	0.2	0.8	2.8	0.1	1.8	0.1
REM 300	368.9	100	0.2	0.7	2.7	0.1	1.9	0.1
REM 400	469.5	100	0.1	0.7	2.7	0.1	1.8	0.1
REM 500	571.0	100	0.1	0.7	2.6	0.1	1.8	0.1
REM 600	669.0	100	0.1	0.2	2.4	0.1	1.9	0.1
REM 700	771.3	100	0.1	0.1	2.7	0.1	1.9	0.1
REM 800	871.2	100	0.1	0.1	3.0	0.1	2.2	0.1
REM 900	970.0	100	0.1	0.1	2.5	0.1	1.9	0.1
REM 1000	1071.4	100	0.1	0.2	2.6	0.1	2.6	0.1
REM 1100	1169.4	100	0.1	0.1	2.5	0.1	2.0	0.1
REM 1200	1270.1	100	0.1	0.2	2.4	0.1	1.9	0.1
REM 1300	1369.5	100	0.0	0.1	2.4	0.1	1.9	0.1
REM 1400	1469.6	100	0.1	0.2	2.5	0.1	1.9	0.1
REM 1500	1578.9	100	0.1	0.1	2.6	0.1	2.0	0.1
REM 1500	1578.9	75	0.1	0.1	2.0	0.1	1.6	0.1
REM 1500	1578.9	50	0.1	0.1	2.4	0.1	1.1	0.0
REM 1500	1578.9	25	0.1	0.2	1.2	0.0	0.7	0.0
REM 1500/Pre-Rail	1578.9	100	0.1	0.2	2.6	0.1	1.9	0.1
Post-Rail Impact	1584.3	100	0.1	0.2	2.1	0.1	1.9	0.1
Post-Rail Retest	1586.4	100	0.0	0.1	1.9	0.1	2.0	0.1

[ ] = Purchase Description requirement.

**TABLE B-2.2-4. FREQUENCY AND VOLTAGE REGULATION, STABILITY  
AND TRANSIENT RESPONSE TEST FOR GENERATOR SET NO. 3-2  
(FREQUENCY)**

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
			[3.0]	[4.0]	[4.0]	[4.0]	[5.0]	[6.0]
Initial	75.1	100	0.0	0.0	0.0	0.0	0.0	0.0
Initial	75.1	75	0.0	0.0	0.0	0.0	0.0	0.0
Initial	75.1	50	0.0	0.0	0.0	0.0	0.0	0.0
Initial	75.1	25	0.0	0.0	0.0	0.0	0.0	0.0
Initial	75.1	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 0	80.9	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 0	80.9	75	0.0	0.0	0.0	0.0	0.0	0.0
REM 0	80.9	50	0.0	0.0	0.0	0.0	0.0	0.0
REM 0	80.9	25	0.0	0.0	0.0	0.0	0.0	0.0
REM 0	80.9	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 100	164.8	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 200	265.3	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 300	368.9	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 400	469.5	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 500	571.0	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 600	669.0	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 700	771.3	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 800	871.2	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 900	960.0	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1000	1058.2	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1100	1157.4	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1200	1257.2	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1300	1359.0	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1400	1457.3	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1500	1578.9	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1500	1578.9	75	0.0	0.0	0.0	0.0	0.0	0.0
REM 1500	1578.9	50	0.0	0.0	0.0	0.0	0.0	0.0
REM 1500	1578.9	25	0.0	0.0	0.0	0.0	0.0	0.0
REM 1500/Pre-Rail	1578.9	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Rail Impact	1584.3	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Rail Retest	1586.4	100	0.0	0.0	0.0	0.0	0.0	0.0

[ ] = Purchase Description requirement.

TABLE B-2.2-5. FREQUENCY AND VOLTAGE REGULATION, STABILITY AND TRANSIENT RESPONSE TEST FOR GENERATOR SET NO. 3-3 (VOLTAGE)

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
			[4.0]	[2.0]	[30.0]	[3.0]	[30.0]	[3.0]
Initial	68.1	100	0.0	0.2	1.4	0.1	1.2	0.0
Initial	68.1	75	0.1	0.2	1.2	0.0	0.9	0.0
Initial	68.1	50	0.0	0.1	1.0	0.0	0.7	0.0
Initial	68.1	25	0.1	0.2	0.6	0.0	0.4	0.0
Initial	68.1	100	0.1	0.2	1.3	0.0	1.2	0.0
REM 0	70.4	100	0.3	0.7	4.9	0.3	6.3	0.2
REM 0	70.4	75	0.4	0.5	4.8	0.3	5.4	0.2
REM 0	70.4	50	0.4	0.6	3.8	0.1	3.5	0.1
REM 0	70.4	25	0.2	0.4	1.9	0.1	1.8	0.1
REM 0	70.4	100	0.3	0.8	4.7	0.3	6.8	0.2
REM 100	159.0	100	0.2	0.2	2.9	0.1	2.3	0.1
REM 200	260.1	100	0.2	0.3	2.7	0.1	2.2	0.1
REM 300	357.8	100	0.1	0.2	1.9	0.1	2.1	0.1
REM 400	458.0	100	0.1	0.2	2.1	0.1	2.2	0.1
REM 500	557.1	100	0.1	0.2	2.0	0.1	2.1	0.1
REM 600	657.2	100	0.2	0.4	2.3	0.1	2.2	0.1
REM 700	759.8	100	0.1	0.2	1.9	0.1	2.2	0.1
REM 800	857.3	100	0.2	0.2	2.1	0.1	2.5	0.1
REM 900	960.0	100	0.2	0.2	2.3	0.1	2.2	0.1
REM 1000	1057.2	100	0.2	1.5	2.3	0.1	2.3	0.1
REM 1100	1157.4	100	0.2	0.3	2.2	0.1	2.3	0.1
REM 1200	1257.2	100	0.2	0.2	3.0	0.1	2.4	0.1
REM 1300	1358.9	100	0.2	0.3	2.3	0.1	2.4	0.1
REM 1400	1457.3	100	0.2	0.3	2.5	0.1	2.5	0.1
REM 1500	1558.1	100	0.2	0.2	2.5	0.1	2.4	0.1
REM 1500	1558.1	75	0.1	0.1	2.0	0.1	1.4	0.1
REM 1500	1558.1	50	0.1	0.1	1.7	0.1	1.0	0.0
REM 1500	1558.1	25	0.1	0.1	1.8	0.1	0.7	0.0
REM 1500/Pre-Rail	1558.1	100	0.2	0.2	2.2	0.1	2.3	0.1
Post-Rail Impact	1572.7	100	0.2	0.5	2.9	0.1	2.5	0.1
Post-Rail Retest	1574.3	100	0.2	1.2	2.3	0.1	2.3	0.1

[ ] = Purchase Description requirement.

TABLE B-2.2-6. FREQUENCY AND VOLTAGE REGULATION, STABILITY AND TRANSIENT RESPONSE TEST FOR GENERATOR SET NO. 3-3 (FREQUENCY)

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
			[3.0]	[4.0]	[4.0]	[4.0]	[5.0]	[6.0]
Initial	68.1	100	0.0	0.0	0.0	0.0	0.0	0.0
Initial	68.1	75	0.0	0.0	0.0	0.0	0.0	0.0
Initial	68.1	50	0.0	0.0	0.0	0.0	0.0	0.0
Initial	68.1	25	0.0	0.0	0.0	0.0	0.0	0.0
Initial	68.1	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 0	70.4	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 0	70.4	75	0.0	0.0	0.0	0.0	0.0	0.0
REM 0	70.4	50	0.0	0.0	0.0	0.0	0.0	0.0
REM 0	70.4	25	0.0	0.0	0.0	0.0	0.0	0.0
REM 0	70.4	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 100	159.0	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 200	260.1	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 300	357.8	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 400	458.0	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 500	557.1	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 600	657.2	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 700	759.8	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 800	857.3	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 900	960.0	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1000	1057.2	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1100	1157.4	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1200	1257.2	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1300	1358.9	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1400	1457.3	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1500	1558.1	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1500	1558.1	75	0.0	0.0	0.0	0.0	0.0	0.0
REM 1500	1558.1	50	0.0	0.0	0.0	0.0	0.0	0.0
REM 1500	1558.1	25	0.0	0.0	0.0	0.0	0.0	0.0
REM 1500/Pre-Rail	1558.1	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Rail Impact	1572.7	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Rail Retest	1574.3	100	0.0	0.0	0.0	0.0	0.0	0.0

[ ] = Purchase Description requirement.

TABLE B-2.2-7. FREQUENCY AND VOLTAGE REGULATION, STABILITY AND TRANSIENT RESPONSE TEST FOR GENERATOR SET NO. 3-4 (VOLTAGE)

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
			[4.0]	[2.0]	[30.0]	[3.0]	[30.0]	[3.0]
Initial	58.5	100	0.0	0.2	1.6	0.1	1.4	0.0
Initial	58.5	75	0.0	0.2	1.4	0.1	1.1	0.0
Initial	58.5	50	0.0	0.2	1.2	0.0	0.8	0.1
Initial	58.5	25	0.1	0.2	0.7	0.0	0.5	0.0
Initial/Pre-Altitude	58.5	100	0.0	0.1	1.7	0.1	1.4	0.1
Altitude-1000 ft	63.4	100	0.1	0.1	2.9	0.1	2.2	0.1
Altitude-1000 ft	63.4	75	0.2	0.1	2.3	0.1	1.4	0.0
Altitude-1000 ft	63.4	50	0.1	0.2	2.6	0.1	1.1	0.0
Altitude-1000 ft	63.4	25	0.1	0.2	2.6	0.1	2.3	0.1
Altitude-1000 ft	63.4	100	0.1	0.1	3.3	0.1	2.3	0.1
Altitude-4000 ft	67.7	100	0.3	0.2	1.7	0.1	1.5	0.1
Altitude-4000 ft	67.7	75	0.3	0.2	1.4	0.1	1.2	0.0
Altitude-4000 ft	67.7	50	0.2	0.2	1.3	0.0	0.7	0.0
Altitude-4000 ft	67.7	25	0.1	0.2	0.6	0.0	0.4	0.0
Altitude-4000 ft	67.7	100	0.3	0.1	1.6	0.1	1.5	0.1
Altitude-8000 ft	78.5	100	0.1	0.1	1.9	0.1	2.3	0.1
Altitude-8000 ft	78.5	75	0.2	0.1	1.6	0.1	1.4	0.0
Altitude-8000 ft	78.5	50	0.1	0.2	1.3	0.1	1.2	0.0
Altitude-8000 ft	78.5	25	0.1	0.2	1.1	0.1	2.3	0.1
Altitude-8000 ft	78.5	100	0.1	0.1	3.3	0.1	2.4	0.1
REM 0	94.3	100	0.3	0.7	4.9	0.3	6.3	0.2
REM 0	94.3	75	0.4	0.5	4.8	0.3	5.4	0.2
REM 0	94.3	50	0.4	0.6	3.8	0.1	3.5	0.1
REM 0	94.3	25	0.2	0.4	1.9	0.1	1.7	0.1
REM 0	94.3	100	0.3	0.8	4.7	0.3	6.8	0.2
REM 100	166.1	100	0.2	0.3	4.2	0.3	5.4	0.2
REM 200	263.6	100	0.2	0.4	4.4	0.3	5.8	0.2
REM 300	374.2	100	0.2	0.3	4.1	0.2	5.6	0.2
REM 400	473.5	100	0.2	0.3	3.7	0.2	5.3	0.2
REM 500	563.8	100	0.2	0.4	4.4	0.2	5.7	0.3
REM 600	664.3	100	0.3	0.3	3.9	0.2	5.4	0.3
REM 700	764.3	100	0.4	0.7	4.7	0.3	6.4	0.3
REM 800	869.1	100	0.3	0.9	5.5	0.2	4.3	0.3
REM 900	964.3	100	0.2	0.3	3.6	0.2	4.9	0.1
REM 1000	1064.3	100	0.4	1.0	5.0	0.3	6.8	0.2
REM 1100	1168.6	100	0.3	1.0	4.5	0.1	5.6	0.3
REM 1200	1265.2	100	0.2	1.0	4.3	0.1	5.6	0.3
REM 1300	1365.1	100	0.2	0.3	4.4	0.1	5.4	0.1
REM 1400	1464.4	100	0.4	1.6	4.7	0.3	5.2	0.1

[ ] = Purchase Description requirement.

TABLE B-2.2-7 (CONT'D)

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
			[4.0]	[2.0]	[30.0]	[3.0]	[30.0]	[3.0]
REM 1500	1570.5	100	0.8	1.5	4.1	0.4	4.5	0.1
REM 1500	1570.5	75	0.9	1.6	3.7	0.5	3.6	0.1
REM 1500	1570.5	50	0.8	1.6	3.3	0.2	2.7	0.1
REM 1500	1570.5	25	1.3	1.9	3.8	0.1	1.8	0.1
REM 1500/Pre-Rail	1570.5	100	0.6	1.8	4.6	0.2	4.6	0.1
Post-Rail Impact	1665.1	100	0.1	0.2	3.4	0.1	4.3	0.1
Post-Rail Retest	1667.7	100	0.5	1.5	3.8	0.2	2.5	0.1

[ ] = Purchase Description requirement.

TABLE B-2.2-8. FREQUENCY AND VOLTAGE REGULATION, STABILITY AND TRANSIENT RESPONSE TEST FOR GENERATOR SET NO. 3-4 (FREQUENCY)

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
			[3.0]	[4.0]	[4.0]	[4.0]	[5.0]	[6.0]
Initial	58.5	100	0.0	0.0	0.0	0.0	0.0	0.0
Initial	58.5	75	0.0	0.0	0.0	0.0	0.0	0.0
Initial	58.5	50	0.0	0.0	0.0	0.0	0.0	0.0
Initial	58.5	25	0.0	0.0	0.0	0.0	0.0	0.0
Initial/Pre-Altitude	58.5	100	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-1000 ft	63.4	100	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-1000 ft	63.4	75	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-1000 ft	63.4	50	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-1000 ft	63.4	25	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-1000 ft	63.4	100	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-4000 ft	67.7	100	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-4000 ft	67.7	75	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-4000 ft	67.7	50	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-4000 ft	67.7	25	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-4000 ft	67.7	100	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-8000 ft	78.5	100	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-8000 ft	78.5	75	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-8000 ft	78.5	50	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-8000 ft	78.5	25	0.0	0.0	0.0	0.0	0.0	0.0
Altitude-8000 ft	78.5	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 0	94.3	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 0	94.3	75	0.0	0.0	0.0	0.0	0.0	0.0
REM 0	94.3	50	0.0	0.0	0.0	0.0	0.0	0.0
REM 0	94.3	25	0.0	0.0	0.0	0.0	0.0	0.0
REM 0	94.3	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 100	166.1	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 200	263.6	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 300	374.2	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 400	473.5	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 500	563.8	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 600	664.3	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 700	764.3	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 800	869.1	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 900	964.3	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1000	1064.3	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1100	1168.6	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1200	1265.2	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1300	1365.1	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1400	1464.4	100	0.0	0.0	0.0	0.0	0.0	0.0

[ ] = Purchase Description requirement.



TABLE B-2.2-8 (CONT'D)

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
			[3.0]	[4.0]	[4.0]	[4.0]	[5.0]	[6.0]
REM 1500	1558.1	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1500	1558.1	75	0.0	0.0	0.0	0.0	0.0	0.0
REM 1500	1558.1	50	0.0	0.0	0.0	0.0	0.0	0.0
REM 1500	1558.1	25	0.0	0.0	0.0	0.0	0.0	0.0
REM 1500/Pre-Rail	1558.1	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Rail Impact	1572.7	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Rail Retest	1574.3	100	0.0	0.0	0.0	0.0	0.0	0.0

[ ] = Purchase Description requirement.

TABLE B-2.2-9. FREQUENCY AND VOLTAGE REGULATION, STABILITY AND TRANSIENT RESPONSE TEST FOR GENERATOR SET NO. 3-5 (VOLTAGE)

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
			[4.0]	[2.0]	[30.0]	[3.0]	[30.0]	[3.0]
Initial	57.5	100	0.0	0.2	1.6	0.1	1.4	0.0
Initial	57.5	75	0.0	0.2	1.4	0.1	1.1	0.0
Initial	57.5	50	0.0	0.2	1.2	0.0	0.8	0.0
Initial	57.5	25	0.1	0.2	0.7	0.0	0.5	0.0
Initial	57.5	100	0.0	0.1	1.7	0.1	1.4	0.0
REM 0	73.2	100	0.1	0.1	2.9	0.1	2.2	0.1
REM 0	73.2	75	0.2	0.1	2.3	0.1	1.4	0.0
REM 0	73.2	50	0.1	0.2	2.6	0.1	1.1	0.0
REM 0	73.2	25	0.1	0.2	2.6	0.1	2.3	0.1
REM 0	73.2	100	0.1	0.1	3.3	0.1	2.3	0.1
REM 100	148.1	100	0.1	0.2	3.2	0.1	2.3	0.1
REM 200	249.0	100	0.2	1.5	3.0	0.1	2.3	0.1
REM 300	349.4	100	0.0	0.1	2.6	0.1	2.4	0.1
REM 400	448.6	100	0.1	1.2	2.9	0.1	2.5	0.1
REM 500	548.8	100	0.1	0.2	2.4	0.1	2.1	0.1
REM 600	648.5	100	0.1	0.2	2.4	0.1	2.3	0.1
REM 700	748.2	100	0.3	1.4	2.4	0.1	2.1	0.1
REM 800	848.8	100	0.3	1.3	2.4	0.1	2.1	0.1
REM 900	948.4	100	0.1	1.6	2.9	0.1	2.2	0.1
REM 1000	1048.2	100	0.1	0.1	2.9	0.1	2.2	0.1
REM 1100	1149.8	100	0.1	0.2	3.0	0.1	2.4	0.1
REM 1200	1248.7	100	0.1	0.2	3.0	0.1	2.4	0.1
REM 1300	1350.9	100	0.1	0.2	2.7	0.1	2.3	0.1
REM 1400	1448.0	100	0.1	0.2	2.4	0.1	2.3	0.1
REM 1500	1561.2	100	0.1	0.1	2.7	0.1	2.3	0.1
REM 1500	1561.2	75	0.1	0.1	1.8	0.1	1.5	0.0
REM 1500	1561.2	50	0.0	0.2	1.5	0.1	1.1	0.0
REM 1500	1561.2	25	0.1	0.2	1.0	0.0	0.7	0.0
REM 1500/Pre-Rail	1561.2	100	0.1	0.1	2.6	0.1	2.4	0.1
Post-Rail Impact	1563.5	100	0.1	0.1	2.1	0.1	2.3	0.1
Post-Rail Retest	1564.9	100	0.0	0.1	2.0	0.1	2.4	0.1

[ ] = Purchase Description requirement.

TABLE B-2.2-10. FREQUENCY AND VOLTAGE REGULATION, STABILITY AND TRANSIENT RESPONSE TEST FOR GENERATOR SET NO. 3-5 (FREQUENCY)

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
			[3.0]	[4.0]	[4.0]	[4.0]	[5.0]	[6.0]
Initial	57.5	100	0.0	0.0	0.0	0.0	0.0	0.0
Initial	57.5	75	0.0	0.0	0.0	0.0	0.0	0.0
Initial	57.5	50	0.0	0.0	0.0	0.0	0.0	0.0
Initial	57.5	25	0.0	0.0	0.0	0.0	0.0	0.0
Initial	57.5	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 0	73.2	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 0	73.2	75	0.0	0.0	0.0	0.0	0.0	0.0
REM 0	73.2	50	0.0	0.0	0.0	0.0	0.0	0.0
REM 0	73.2	25	0.0	0.0	0.0	0.0	0.0	0.0
REM 0	73.2	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 100	148.1	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 200	249.0	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 300	349.4	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 400	448.6	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 500	548.8	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 600	648.5	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 700	748.2	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 800	848.8	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 900	948.4	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1000	1048.2	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1100	1149.8	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1200	1248.7	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1300	1350.9	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1400	1448.0	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1500	1561.2	100	0.0	0.0	0.0	0.0	0.0	0.0
REM 1500	1561.2	75	0.0	0.0	0.0	0.0	0.0	0.0
REM 1500	1561.2	50	0.0	0.0	0.0	0.0	0.0	0.0
REM 1500	1561.2	25	0.0	0.0	0.0	0.0	0.0	0.0
REM 1500	1561.2	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Rail Impact	1563.5	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Rail Retest	1564.9	100	0.0	0.0	0.0	0.0	0.0	0.0

[ ] = Purchase Description requirement.

TABLE B-2.2-11. FREQUENCY AND VOLTAGE REGULATION, STABILITY AND TRANSIENT RESPONSE TEST FOR GENERATOR SET NO. 3-6 (VOLTAGE)

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
			[4.0]	[2.0]	[30.0]	[3.0]	[30.0]	[3.0]
Initial	56.4	100	0.1	0.1	1.5	0.16	1.6	0.1
Initial	56.4	75	0.1	0.2	1.2	0.0	1.5	0.1
Initial	56.4	50	0.1	0.2	0.8	0.0	1.3	0.0
Initial	56.4	25	0.0	0.2	0.6	0.0	0.8	0.0
Initial	56.4	100	0.1	0.1	1.5	0.1	1.7	0.1
Post-Actuator Mod	62.3	100	0.1	0.2	1.8	0.1	2.5	0.1
Post-Actuator Mod	62.3	75	0.1	0.1	2.5	0.1	1.6	0.1
Post-Actuator Mod	62.3	50	0.1	0.1	1.5	0.1	1.1	0.0
Post-Actuator Mod	62.3	25	0.1	0.2	1.9	0.1	0.7	0.0
Post-Act./Pre-Env	62.3	100	0.1	0.1	2.2	0.1	2.5	0.1
High Temp	65.6	100	0.2	0.2	2.7	0.1	3.1	0.1
High Temp	65.6	75	0.2	0.2	2.3	0.1	1.9	0.1
High Temp	65.6	50	0.1	0.1	1.3	0.1	1.3	0.1
High Temp	65.6	25	0.1	0.2	0.9	0.0	0.7	0.0
High Temp	65.6	100	0.2	0.2	2.5	0.1	2.9	0.1
High Temp (post 608.2)	76.7	100	0.3	0.2	3.0	0.1	2.6	0.1
Pre-Voltage Drift Test	87.6	100	0.2	0.2	2.6	0.1	2.5	0.1
Low Temp 20 °F	98.8	100	0.1	0.1	2.3	0.1	2.3	0.1
Low Temp 20 °F	98.8	75	0.1	0.1	2.0	0.1	1.5	0.1
Low Temp 20 °F	98.8	50	0.1	0.1	1.9	0.1	1.0	0.0
Low Temp 20 °F	98.8	25	0.1	0.2	1.4	0.1	0.7	0.0
Low Temp 20 °F	98.8	100	0.1	0.1	2.5	0.1	2.2	0.1
Low Temp -25 °F	162.0	100	0.1	0.1	2.3	0.1	2.2	0.1
Low Temp -25 °F	162.0	75	0.1	0.1	2.0	0.1	1.4	0.0
Low Temp -25 °F	162.0	50	0.1	0.1	1.7	0.1	1.0	0.0
Low Temp -25 °F	162.0	25	0.0	0.1	1.2	0.0	0.6	0.0
Low Temp -25 °F	162.0	100	0.0	0.1	2.3	0.1	2.1	0.1
Pre-Cold Storage	172.6	100	0.1	0.2	2.8	0.1	2.4	0.1
Post-Cold Stor/Pre-Hum	174.5	100	0.2	0.2	2.7	0.1	2.5	0.1
Post-Hum/Pre-Road	175.7	100	0.2	0.1	2.6	0.1	2.9	0.1
Post-1st Road Cycle	176.9	100	0.1	0.1	2.2	0.1	2.6	0.1
Post-2nd Road Cycle	178.1	100	0.1	0.1	2.2	0.1	2.6	0.1
Post-3rd Road Cycle	179.5	100	0.1	0.1	2.2	0.1	2.8	0.1
Post-4th Road/Pre-Solar	181.3	100	0.2	0.1	2.0	0.1	2.8	0.1
Post-Solar	182.6	100	0.2	0.1	1.9	0.1	2.9	0.1

[ ] = Purchase Description requirement.

TABLE B-2.2-12. FREQUENCY AND VOLTAGE REGULATION, STABILITY AND TRANSIENT RESPONSE TEST FOR GENERATOR SET NO. 3-6 (FREQUENCY)

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
			[3.0]	[4.0]	[4.0]	[4.0]	[5.0]	[6.0]
Initial	56.4	100	0.0	0.0	0.0	0.0	0.0	0.0
Initial	56.4	75	0.0	0.0	0.0	0.0	0.0	0.0
Initial	56.4	50	0.0	0.0	0.0	0.0	0.0	0.0
Initial	56.4	25	0.0	0.0	0.0	0.0	0.0	0.0
Initial	56.4	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	62.3	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	62.3	75	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	62.3	50	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	62.3	25	0.0	0.0	0.0	0.0	0.0	0.0
Post-Act./Pre-Env	62.3	100	0.0	0.0	0.0	0.0	0.0	0.0
High Temp	65.6	100	0.0	0.0	0.0	0.0	0.0	0.0
High Temp	65.6	75	0.0	0.0	0.0	0.0	0.0	0.0
High Temp	65.6	50	0.0	0.0	0.0	0.0	0.0	0.0
High Temp	65.6	25	0.0	0.0	0.0	0.0	0.0	0.0
High Temp	65.6	100	0.0	0.0	0.0	0.0	0.0	0.0
High Temp (post 608.2)	76.7	100	0.0	0.0	0.0	0.0	0.0	0.0
Pre-Voltage Drift Test	87.6	100	0.0	0.0	0.0	0.0	0.0	0.0
Low Temp 20 °F	98.8	100	0.0	0.0	0.0	0.0	0.0	0.0
Low Temp 20 °F	98.8	75	0.0	0.0	0.0	0.0	0.0	0.0
Low Temp 20 °F	98.8	50	0.0	0.0	0.0	0.0	0.0	0.0
Low Temp 20 °F	98.8	25	0.0	0.0	0.0	0.0	0.0	0.0
Low Temp 20 °F	98.8	100	0.0	0.0	0.0	0.0	0.0	0.0
Low Temp -25 °F	162.0	100	0.0	0.0	0.0	0.0	0.0	0.0
Low Temp -25 °F	162.0	75	0.0	0.0	0.0	0.0	0.0	0.0
Low Temp -25 °F	162.0	50	0.0	0.0	0.0	0.0	0.0	0.0
Low Temp -25 °F	162.0	25	0.0	0.0	0.0	0.0	0.0	0.0
Low Temp -25 °F	162.0	100	0.0	0.0	0.0	0.0	0.0	0.0
Pre-Cold Storage	172.6	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Cold Stor/Pre-Hum	174.5	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Hum/Pre-Road	175.7	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-1st Road Cycle	176.9	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-2nd Road Cycle	178.1	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-3rd Road Cycle	179.5	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-4th Road/Pre-Solar	181.3	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Solar	182.6	100	0.0	0.0	0.0	0.0	0.0	0.0

[ ] = Purchase Description requirement.

TABLE B-2.2-13. FREQUENCY AND VOLTAGE REGULATION, STABILITY AND TRANSIENT RESPONSE TEST FOR GENERATOR SET NO. 3-7 (VOLTAGE)

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
			[4.0]	[2.0]	[30.0]	[3.0]	[30.0]	[3.0]
Initial	58.4	100	0.1	0.1	2.6	0.1	2.5	0.1
Initial	58.4	75	0.1	0.1	2.2	0.1	1.7	0.1
Initial	58.4	50	0.0	0.1	1.8	0.1	1.3	0.1
Initial	58.4	25	0.0	0.1	1.0	0.0	0.8	0.0
Initial	58.4	100	0.1	0.1	2.6	0.1	2.5	0.0
Post-Actuator Mod	60.6	100	0.1	0.1	2.5	0.1	2.4	0.1
Post-Actuator Mod	60.6	75	0.1	0.1	2.1	0.1	1.6	0.1
Post-Actuator Mod	60.6	50	0.0	0.1	1.9	0.1	1.2	0.1
Post-Actuator Mod	60.6	25	0.1	0.2	1.1	0.0	0.7	0.0
Post-Act./Pre-Road	60.6	100	0.1	0.2	2.6	0.1	2.4	0.1
Post-1st Road Cycle	65.5	100	0.1	0.2	2.6	0.1	2.4	0.1
Post-2nd Road Cycle	70.1	100	0.0	0.1	2.7	0.1	2.4	0.1
Post-3rd Road Cycle	74.5	100	0.1	0.2	2.6	0.1	2.6	0.1
Post-4th Road/Pre-Rail	78.8	100	0.0	0.2	3.0	0.1	2.6	0.1
Post-Rail Impact	80.1	100	0.1	0.2	2.3	0.1	2.6	0.1

[ ] = Purchase Description requirement.

TABLE B-2.2-14. FREQUENCY AND VOLTAGE REGULATION, STABILITY AND TRANSIENT RESPONSE TEST FOR GENERATOR SET NO. 3-7 (FREQUENCY)

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
			[3.0]	[4.0]	[4.0]	[4.0]	[5.0]	[6.0]
Initial	58.4	100	0.0	0.0	0.0	0.0	0.0	0.0
Initial	58.4	75	0.0	0.0	0.0	0.0	0.0	0.0
Initial	58.4	50	0.0	0.0	0.0	0.0	0.0	0.0
Initial	58.4	25	0.0	0.0	0.0	0.0	0.0	0.0
Initial	58.4	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	60.6	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	60.6	75	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	60.6	50	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	60.6	25	0.0	0.0	0.0	0.0	0.0	0.0
Post-Act./Pre-Road	60.6	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-1st Road Cycle	65.5	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-2nd Road Cycle	70.1	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-3rd Road Cycle	74.5	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-4th Road/Pre-Rail	78.8	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Rail Impact	80.1	100	0.0	0.0	0.0	0.0	0.0	0.0

[ ] = Purchase Description requirement.

TABLE B-2.2-15. FREQUENCY AND VOLTAGE REGULATION, STABILITY AND TRANSIENT RESPONSE TEST FOR GENERATOR SET NO. 3-8 (VOLTAGE)

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
			[4.0]	[2.0]	[30.0]	[3.0]	[30.0]	[3.0]
Initial	56.4	100	0.1	0.2	2.9	0.1	3.0	0.1
Initial	56.4	75	0.1	0.2	2.4	0.1	2.4	0.1
Initial	56.4	50	0.0	0.1	2.0	0.1	1.8	0.1
Initial	56.4	25	0.0	0.2	1.7	0.1	1.0	0.0
Initial	56.4	100	0.1	0.2	3.0	0.1	3.0	0.1
Post-Actuator Mod	127.0	100	0.1	0.2	2.8	0.1	2.9	0.1
Post-Actuator Mod	127.0	75	0.1	0.2	2.8	0.1	2.2	0.1
Post-Actuator Mod	127.0	50	0.0	0.1	3.4	0.1	1.7	0.1
Post-Actuator Mod	127.0	25	0.0	0.2	1.4	0.1	1.1	0.0
Post-Act./Pre-Road	127.0	100	0.1	0.1	3.4	0.1	2.9	0.1
Post-1st Road Cycle	176.7	100	0.1	0.1	2.3	0.1	2.8	0.1
Post-2nd Road Cycle	183.2	100	0.1	0.1	3.3	0.1	2.8	0.1
Post-3rd Road Cycle	187.9	100	0.1	0.2	2.5	0.1	2.8	0.1
Post-4th Road/Pre-Rail	189.0	100	0.1	0.2	2.6	0.1	2.9	0.1
Post Rail Impact/Pre-NBC	191.0	100	0.1	0.2	2.9	0.1	2.8	0.1
Post-1st NBC Cycle	192.2	100	0.1	0.2	2.9	0.1	2.8	0.1
Post-2nd NBC Cycle	194.5	100	0.0	0.2	2.8	0.1	2.6	0.1
Post-3rd NBC Cycle	196.1	100	0.1	0.3	3.1	0.1	2.7	0.1
Post-4th NBC Cycle	197.9	100	0.1	0.1	3.0	0.1	2.8	0.1
Post-5th NBC Cycle	199.5	100	0.1	0.1	3.0	0.1	2.7	0.1

[ ] = Purchase Description requirement.



TABLE B-2.2-16. FREQUENCY AND VOLTAGE REGULATION, STABILITY AND TRANSIENT RESPONSE TEST FOR GENERATOR SET NO. 3-8 (FREQUENCY)

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
			[3.0]	[4.0]	[4.0]	[4.0]	[5.0]	[6.0]
Initial	56.4	100	0.0	0.0	0.0	0.0	0.0	0.0
Initial	56.4	75	0.0	0.0	0.0	0.0	0.0	0.0
Initial	56.4	50	0.0	0.0	0.0	0.0	0.0	0.0
Initial	56.4	25	0.0	0.0	0.0	0.0	0.0	0.0
Initial	56.4	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	127.0	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	127.0	75	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	127.0	50	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	127.0	25	0.0	0.0	0.0	0.0	0.0	0.0
Post-Act./Pre-Road	127.0	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-1st Road Cycle	176.7	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-2nd Road Cycle	183.2	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-3rd Road Cycle	187.9	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-4th Road/Pre-Rail	189.0	100	0.0	0.0	0.0	0.0	0.0	0.0
Post Rail Impact/Pre-NBC	191.0	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-1st NBC Cycle	192.2	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-2nd NBC Cycle	194.5	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-3rd NBC Cycle	196.1	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-4th NBC Cycle	197.9	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-5th NBC Cycle	199.5	100	0.0	0.0	0.0	0.0	0.0	0.0

[ ] = Purchase Description requirement.

TABLE B-2.2-17. FREQUENCY AND VOLTAGE REGULATION, STABILITY AND TRANSIENT RESPONSE TEST FOR GENERATOR SET NO. 3-9 (VOLTAGE)

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
					[30.0]	[3.0]	[30.0]	[3.0]
Initial	57.1	100	0.1	0.2	2.5	0.1	3.2	0.1
Initial	57.1	75	0.1	0.2	1.9	0.1	2.2	0.1
Initial	57.1	50	0.1	0.1	2.0	0.0	1.6	0.1
Initial	57.1	25	0.1	0.2	1.0	0.0	0.8	0.0
Initial	57.1	100	0.1	0.2	2.5	0.1	3.1	0.1
Post-Actuator Mod	62.1	100	0.1	0.1	2.4	0.1	3.1	0.1
Post-Actuator Mod	62.1	75	0.1	0.2	1.9	0.1	2.0	0.1
Post-Actuator Mod	62.1	50	0.1	0.1	2.1	0.0	1.4	0.1
Post-Actuator Mod	62.1	25	0.1	0.2	1.1	0.0	0.8	0.0
Post-Act./Pre-Road	62.1	100	0.1	0.1	2.6	0.1	3.0	0.1
Post-1st Road Cycle	176.3	100	0.1	0.2	2.6	0.1	3.0	0.1
Post-2nd Road Cycle	179.7	100	0.1	0.1	3.0	0.1	3.2	0.1
Post-3rd Road Cycle	183.4	100	0.1	0.2	2.5	0.1	2.9	0.1
Post-4th Road/Pre-Rail	187.7	100	0.1	0.2	3.0	0.1	3.1	0.1
Post Rail Impact/Pre-NBC	188.9	100	0.1	0.2	2.4	0.1	3.0	0.1
Post-1st NBC Cycle	192.0	100	0.1	0.2	3.1	0.1	2.7	0.1
Post-2nd NBC Cycle	194.2	100	0.1	0.2	2.8	0.1	2.7	0.1
Post-3rd NBC Cycle	195.9	100	0.1	0.4	3.4	0.1	2.9	0.1
Post-4th NBC Cycle	199.0	100	0.1	0.2	3.0	0.1	3.0	0.1
Post-5th NBC Cycle	201.6	100	0.1	0.2	3.2	0.1	2.8	0.1

[ ] = Purchase Description requirement.

TABLE B-2.2-18. FREQUENCY AND VOLTAGE REGULATION, STABILITY AND TRANSIENT RESPONSE TEST FOR GENERATOR SET NO. 3-9 (FREQUENCY)

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
			[3.0]	[4.0]	[4.0]	[4.0]	[5.0]	[6.0]
Initial	57.1	100	0.0	0.0	0.0	0.0	0.0	0.0
Initial	57.1	75	0.0	0.0	0.0	0.0	0.0	0.0
Initial	57.1	50	0.0	0.0	0.0	0.0	0.0	0.0
Initial	57.1	25	0.0	0.0	0.0	0.0	0.0	0.0
Initial	57.1	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	62.1	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	62.1	75	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	62.1	50	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	62.1	25	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	62.1	100	0.0	0.0	0.0	0.0	0.0	0.0
Pre-Road Test	128.1	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-1st Road Cycle	176.3	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-2nd Road Cycle	179.7	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-3rd Road Cycle	183.4	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-4th Road/Pre-Rail	187.7	100	0.0	0.0	0.0	0.0	0.0	0.0
Post Rail Impact/Pre-NBC	188.9	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-1st NBC Cycle	192.0	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-2nd NBC Cycle	194.2	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-3rd NBC Cycle	195.9	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-4th NBC Cycle	199.0	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-5th NBC Cycle	201.6	100	0.0	0.0	0.0	0.0	0.0	0.0

[ ] = Purchase Description requirement.

TABLE B-2.2-19. FREQUENCY AND VOLTAGE REGULATION, STABILITY AND TRANSIENT RESPONSE TEST FOR GENERATOR SET NO. 3-10 (VOLTAGE)

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
			[4.0]	[2.0]	[30.0]	[3.0]	[30.0]	[3.0]
Initial	59.1	100	0.1	0.1	2.4	0.1	2.7	0.1
Initial	59.1	75	0.1	0.1	2.6	0.1	2.0	0.1
Initial	59.1	50	0.1	0.1	1.8	0.1	1.5	0.0
Initial	59.1	25	0.0	0.1	2.0	0.0	0.8	0.0
Initial	59.1	100	0.1	0.1	2.6	0.1	2.7	0.1
Post-Actuator Mod	62.1	100	0.1	0.1	2.4	0.1	2.5	0.1
Post-Actuator Mod	62.1	75	0.1	0.1	2.7	0.1	1.9	0.1
Post-Actuator Mod	62.1	50	0.0	0.1	1.6	0.1	1.3	0.0
Post-Actuator Mod	62.1	25	0.1	0.1	2.3	0.0	0.8	0.0
Post-Actuator/Pre-Road	62.1	100	0.1	0.1	2.2	0.1	2.5	0.1
Post-1st Road Cycle	69.4	100	0.1	0.1	2.3	0.1	2.4	0.1
Post-2nd Road Cycle	74.0	100	0.1	0.2	2.6	0.1	2.5	0.1
Post-3rd Road Cycle	78.1	100	0.1	0.2	2.5	0.1	2.6	0.1
Post-4th Road/Pre-Rail	82.8	100	0.1	0.3	2.8	0.1	2.6	0.1
Post-Rail Impact	84.4	100	0.1	0.2	2.1	0.1	2.5	0.1

[ ] = Purchase Description requirement.

TABLE B-2.2-20. FREQUENCY AND VOLTAGE REGULATION, STABILITY AND TRANSIENT RESPONSE TEST FOR GENERATOR SET NO. 3-10 (FREQUENCY)

Test Type	Set, hr	Load, %	Maximum, %		Maximum Undershoot		Maximum Overshoot	
			Regulation	Bandwidth	Trans, %	Rec, Tm, sec	Trans, %	Rec, Tm, sec
			[3.0]	[4.0]	[4.0]	[4.0]	[5.0]	[6.0]
Initial	59.1	100	0.0	0.0	0.0	0.0	0.0	0.0
Initial	59.1	75	0.0	0.0	0.0	0.0	0.0	0.0
Initial	59.1	50	0.0	0.0	0.0	0.0	0.0	0.0
Initial	59.1	25	0.0	0.0	0.0	0.0	0.0	0.0
Initial	59.1	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	62.1	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	62.1	75	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	62.1	50	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator Mod	62.1	25	0.0	0.0	0.0	0.0	0.0	0.0
Post-Actuator/Pre-Road	62.1	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-1st Road Cycle	69.4	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-2nd Road Cycle	74.0	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-3rd Road Cycle	78.1	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-4th Road/Pre-Rail	82.8	100	0.0	0.0	0.0	0.0	0.0	0.0
Post-Rail Impact	84.4	100	0.0	0.0	0.0	0.0	0.0	0.0

[ ] = Purchase Description requirement.

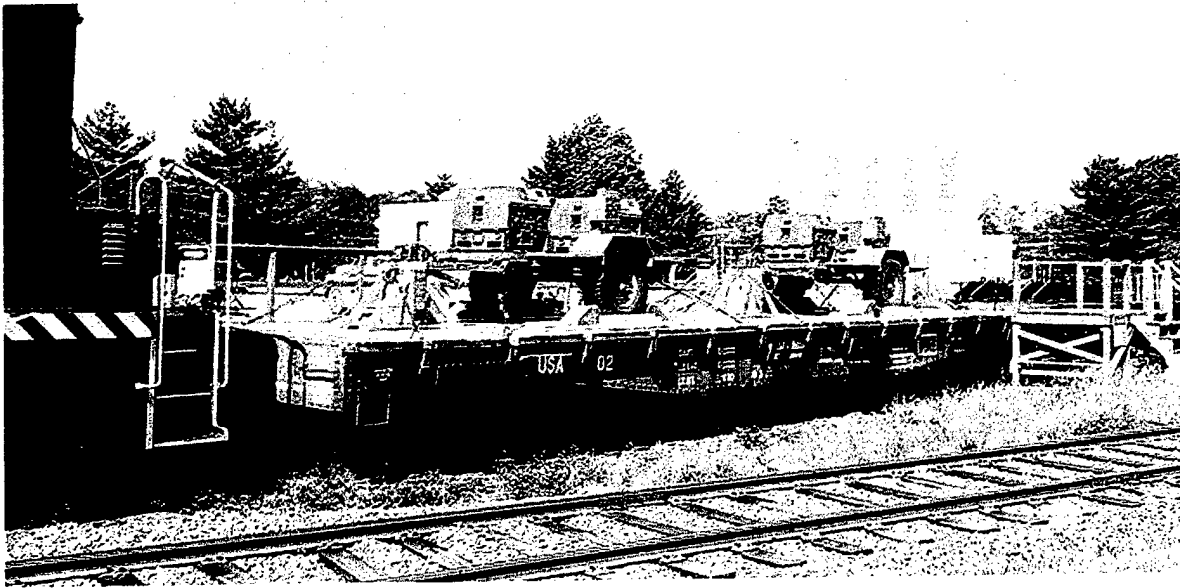


Figure B-2.3-1. Placement of PPs on the railcar.

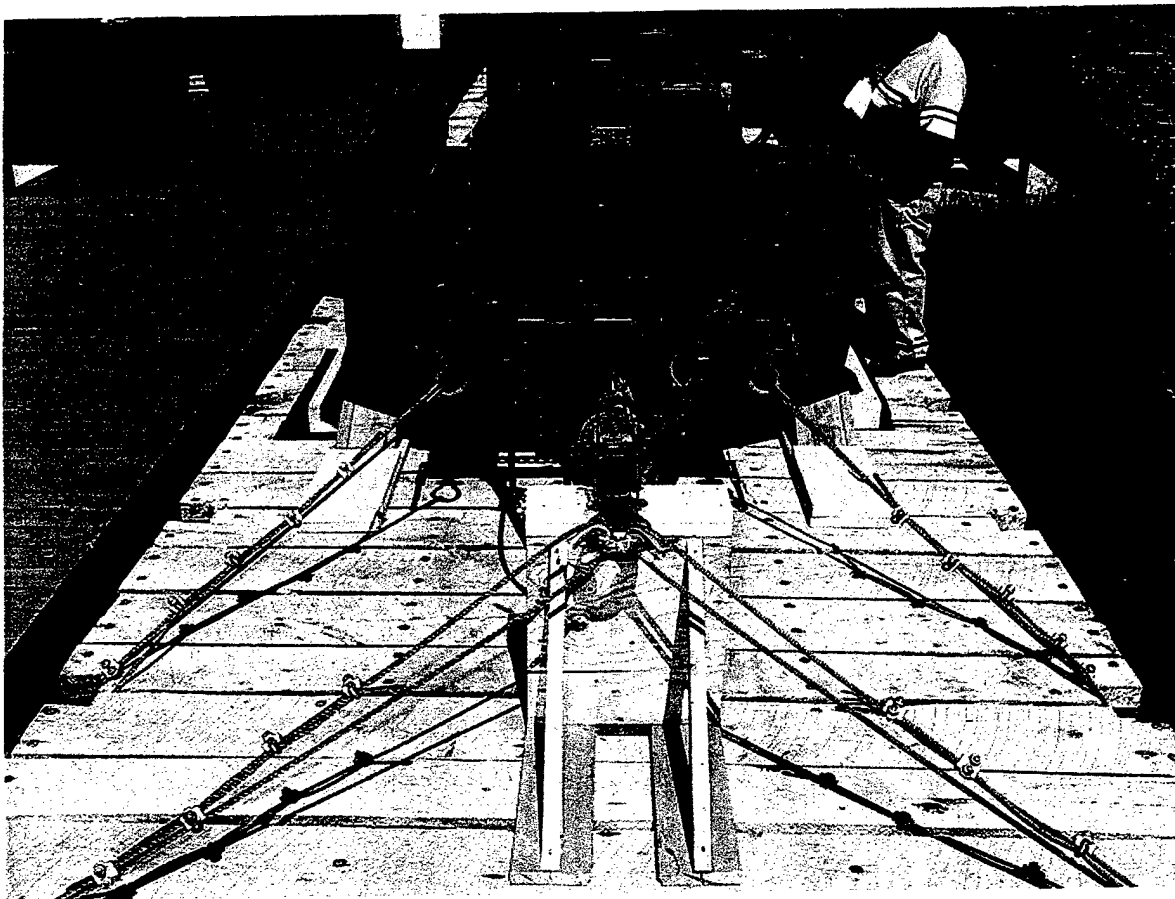


Figure B-2.3-2. Front tie-down and wooden blocking provisions of the PP.



Figure B-2.3-3. Rear tie-downs of the PP.

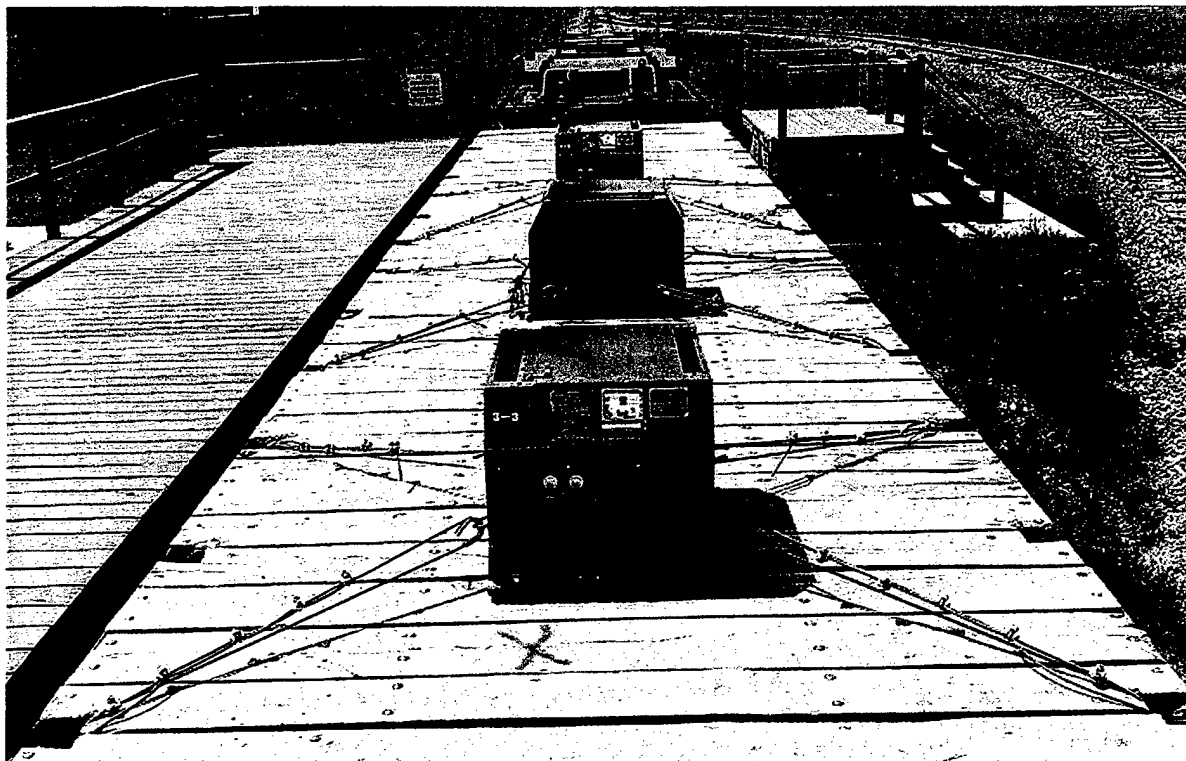


Figure B-2.3-4. First Rail Impact test setup.

B-2.3-2

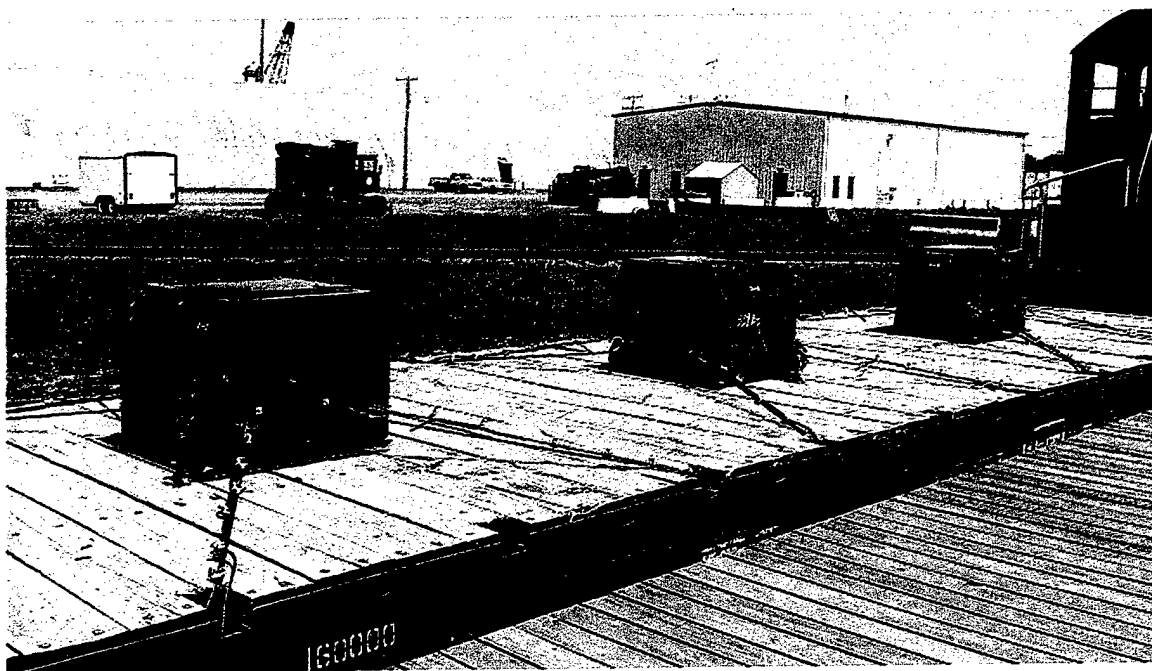


Figure B-2.3-5. First Rail Impact setup.



Figure B-2.3-6. Broken tie-down ring on the right side of generator set No. 3-3 following the forward 8-mph impact.



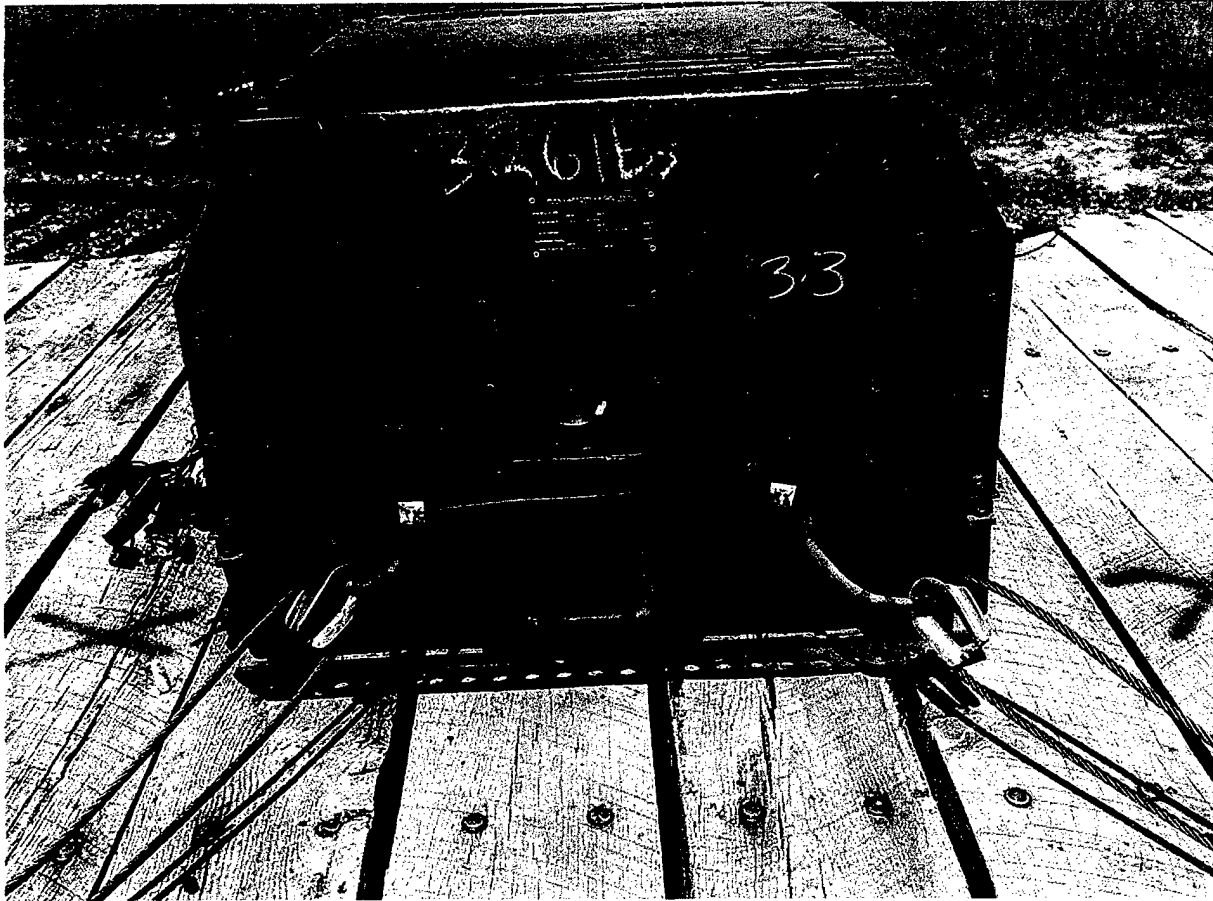


Figure B-2.3-7. Broken tie-down ring on the left side of generator set No. 3-3 following the forward 8-mph impact.

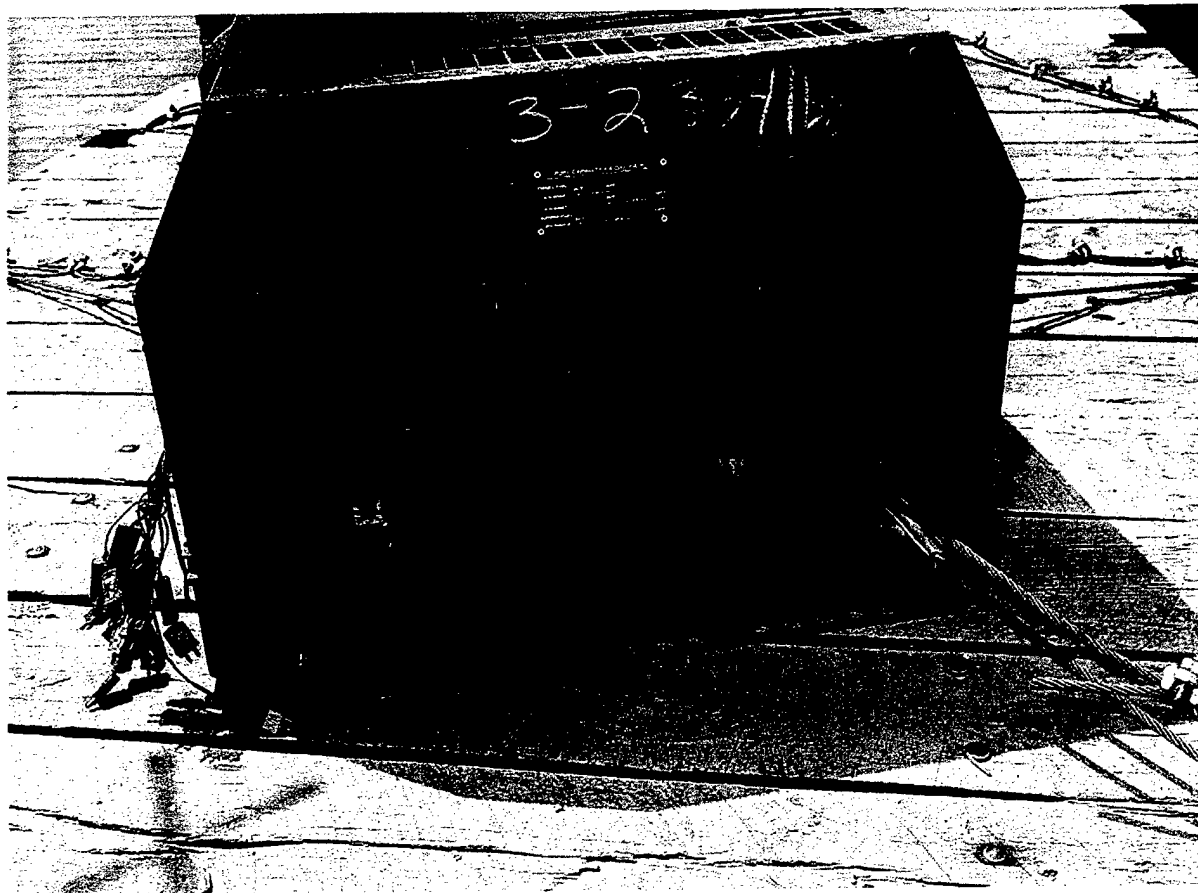


Figure B-2.3-8. Broken tie-down ring on the left side of generator set No. 3-2 following the forward 8-mph impact.

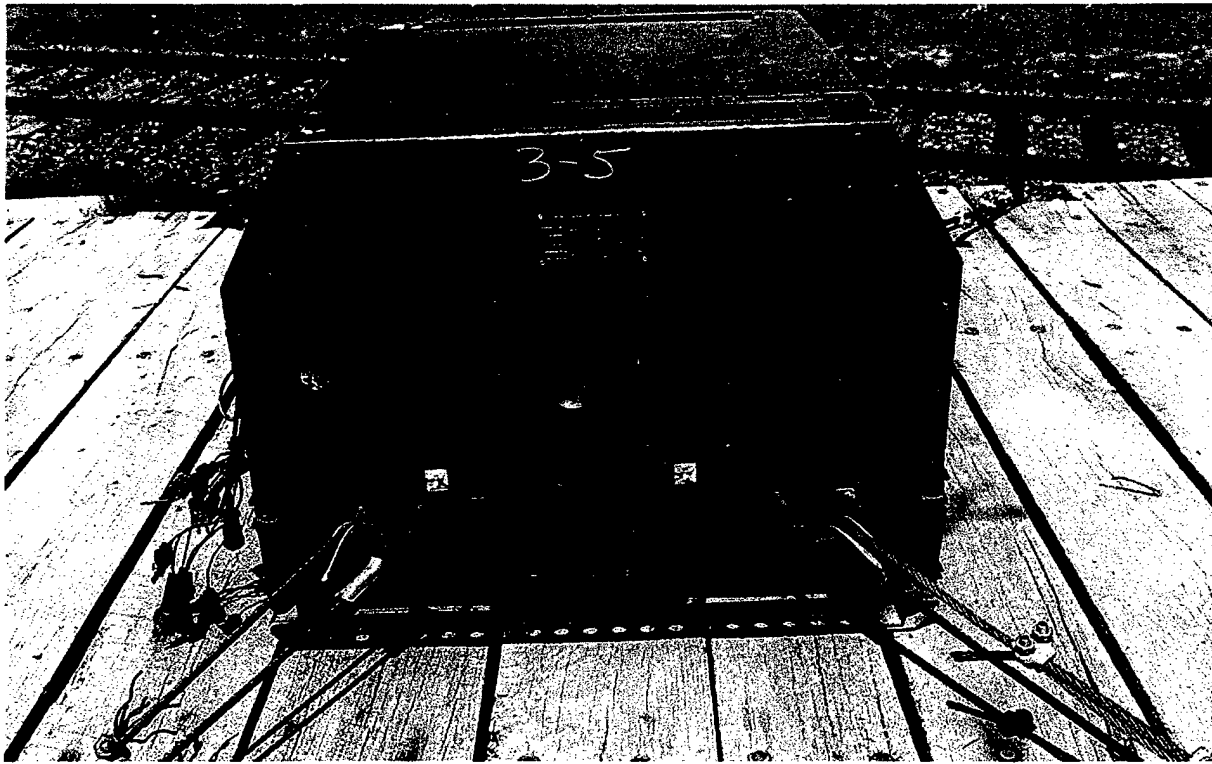


Figure B-2.3-9. Broken tie-down ring on the left side of generator set No. 3-5 following the forward 8-mph impact.

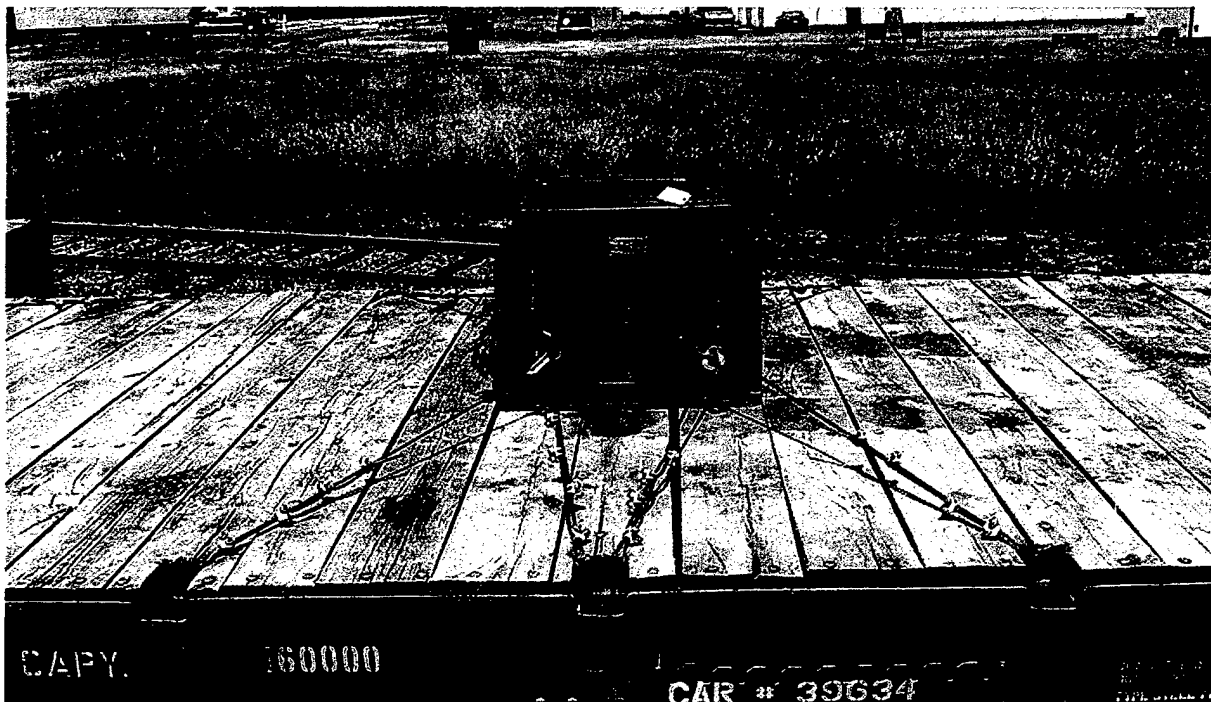


Figure B-2.3-10. Second Rail Impact test setup.

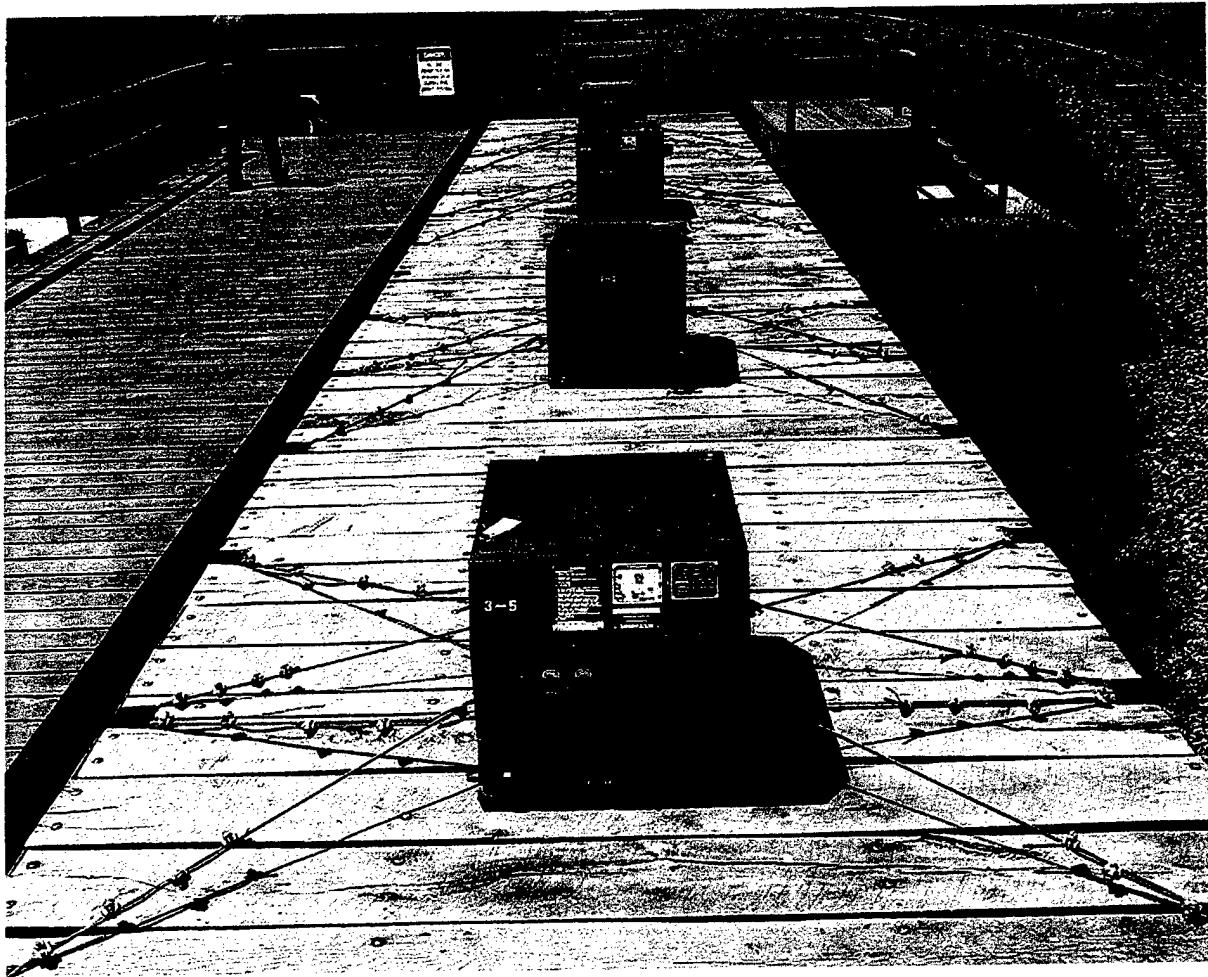


Figure B-2.3-11. Second Rail Impact test setup.

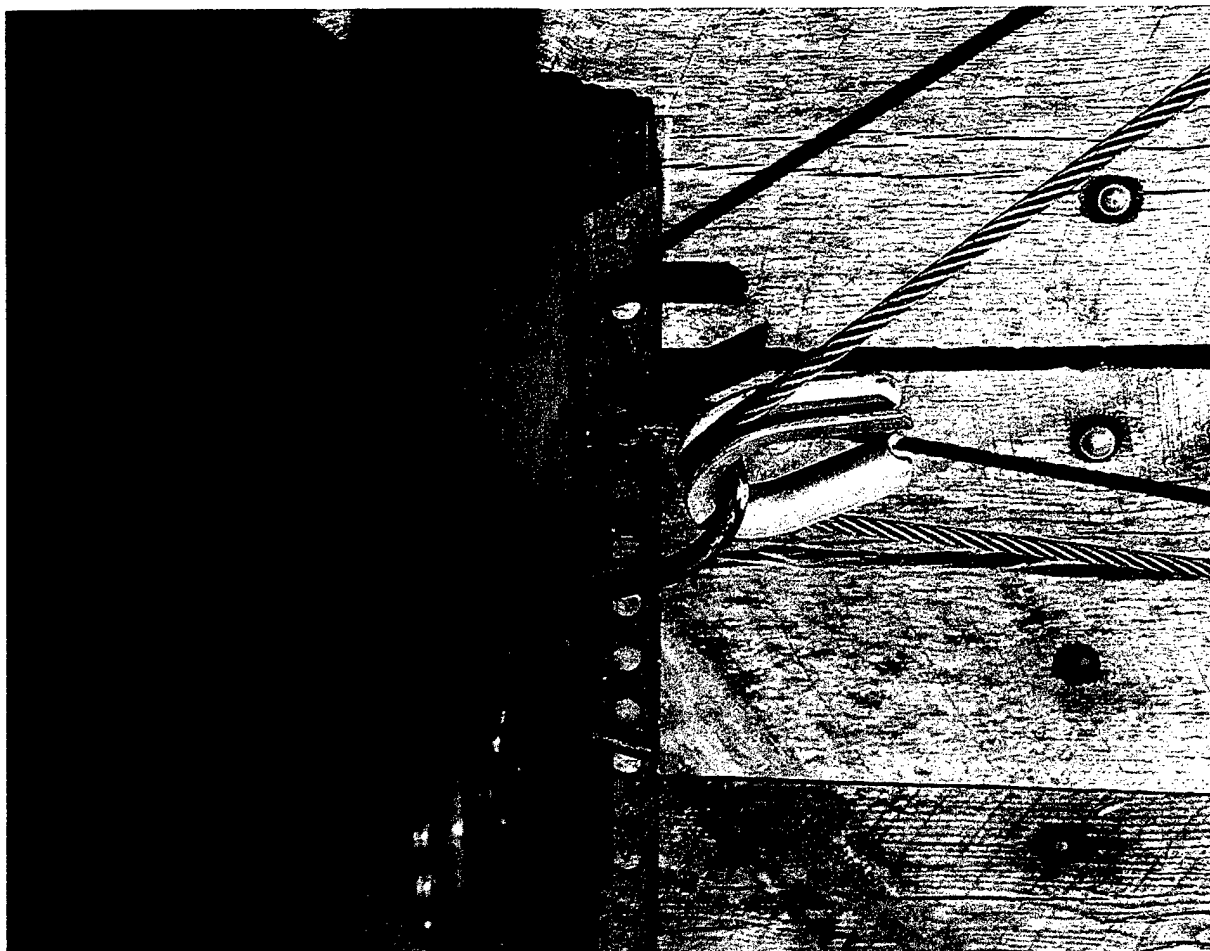


Figure B-2.3-12. Deformed tie-down ring following the reverse 8-mph impact.

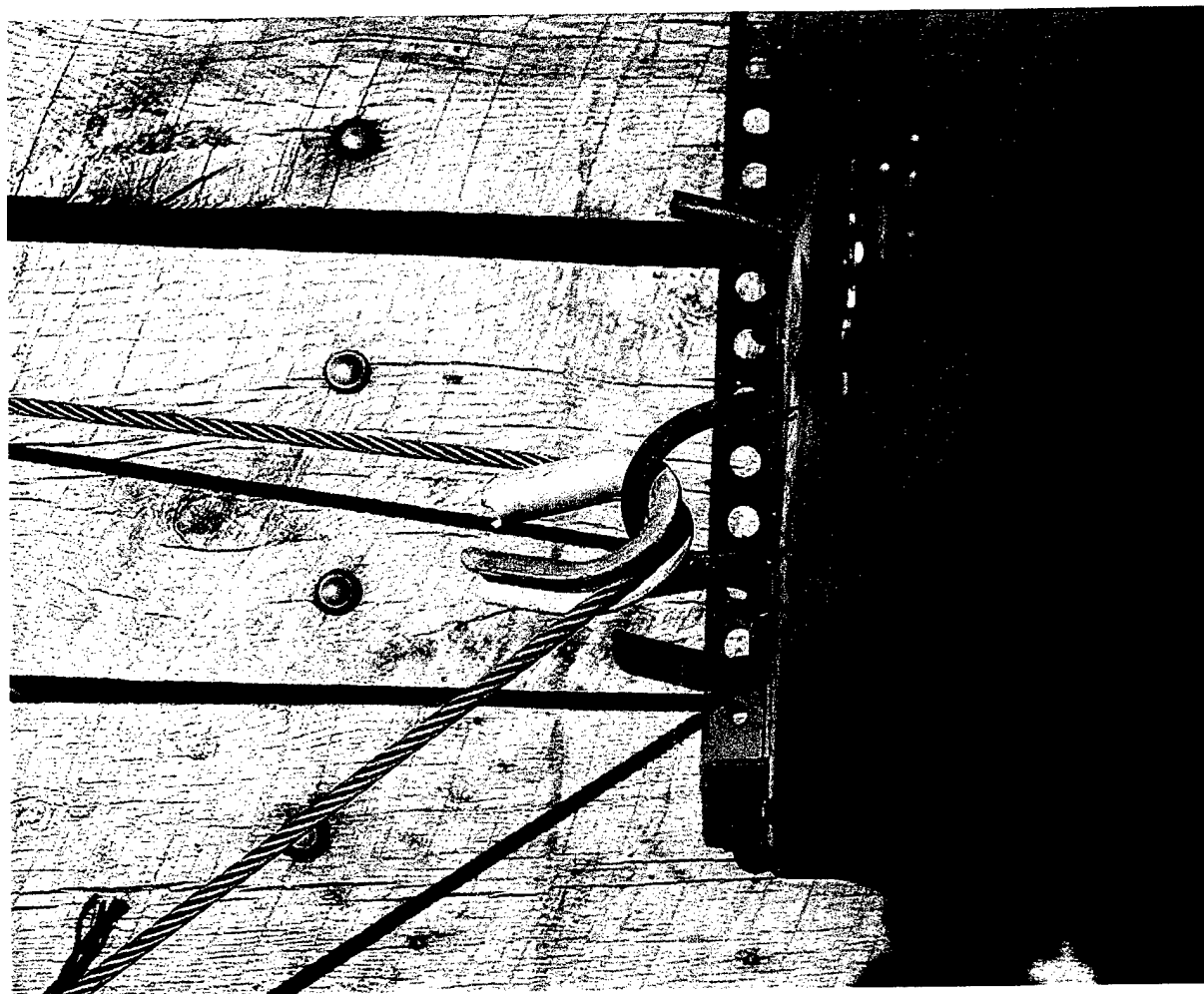


Figure B-2.3-13. Deformed tie-down ring following the reverse 8-mph impact.

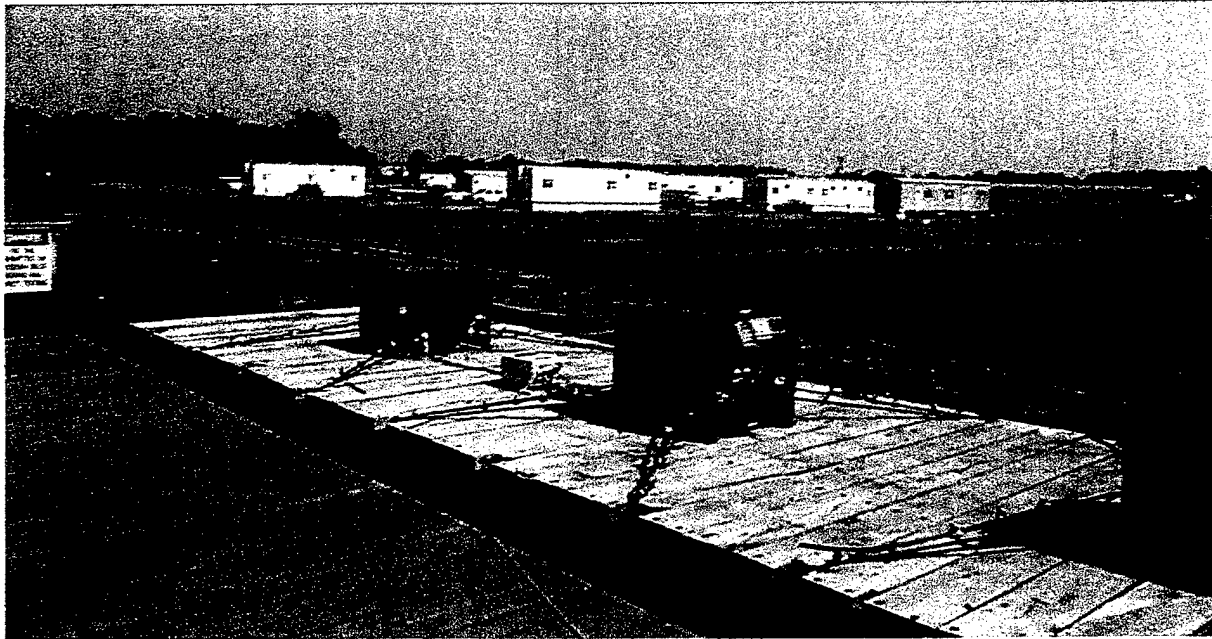


Figure B-2.3-14. Third Rail Impact test setup.

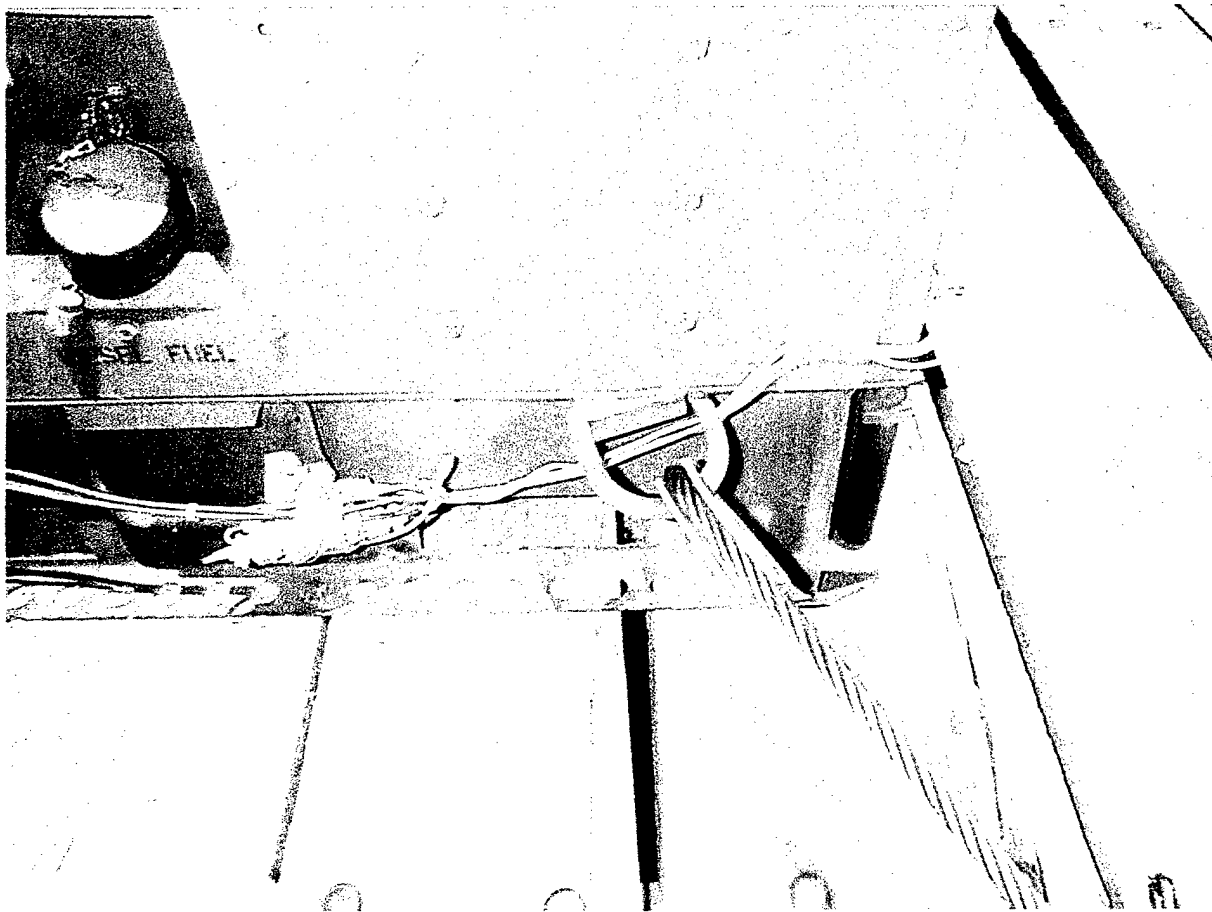


Figure B-2.3-15. Broken tie-down ring following the forward 8-mph impact.

B-2.3-10

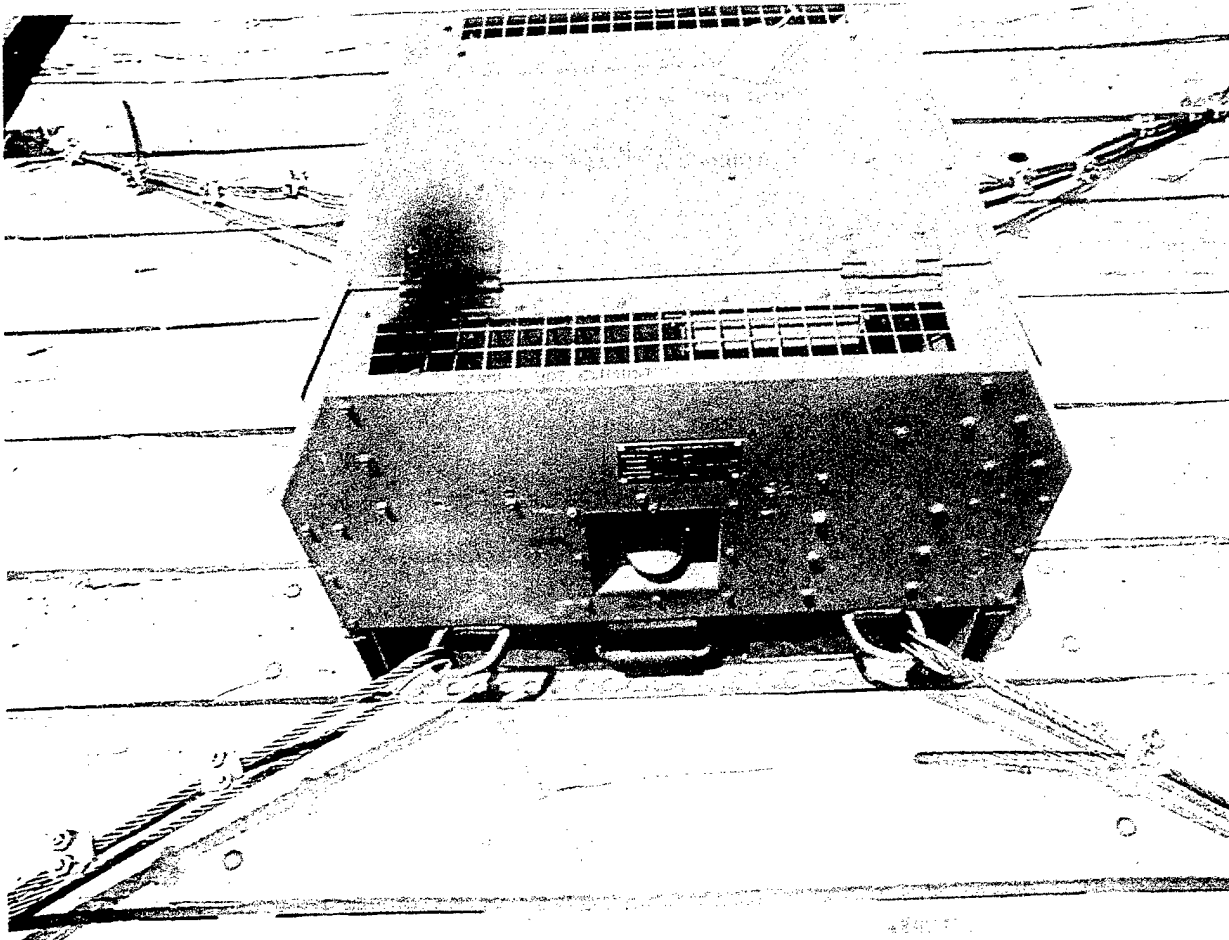


Figure B-2.3-16. Broken tie-down ring following the forward 8-mph impact.



TABLE B-2.3-1. RAIL IMPACT AMPLITUDE DISTRIBUTION DATA

3-kW Generator Set Rail Impact Test  
Run No. 1: Forward - 4.2 mph

DESCRIPTION	RMS	+PEAK	-PEAK	+99.9%	-99.9%	+99%	-99%	+90%	-90%
V) Control panel 1	0.74	6.86	-3.90	4.47	-3.17	2.77	-2.05	0.53	-0.64
T) Control panel 1	0.44	2.59	-3.29	2.59	-3.12	1.35	-1.37	0.39	-0.35
L) Control panel 1	0.80	1.89	-5.73	1.70	-5.63	1.20	-3.70	0.55	-0.56
V) Skid base 1	0.67	5.03	-6.40	4.76	-3.88	2.55	-1.97	0.46	-0.55
T) Skid base 1	0.31	2.48	-2.15	2.16	-1.83	1.03	-0.97	0.21	-0.29
L) Skid base 1	0.86	3.84	-8.77	2.66	-6.25	1.32	-4.02	0.48	-0.49
V) Engine mount 1	0.62	3.79	-4.43	3.68	-3.88	2.21	-1.96	0.44	-0.41
T) Engine mount 1	0.21	0.99	-1.26	0.94	-1.01	0.84	-0.76	0.14	-0.21
L) Engine mount 1	0.79	1.51	-5.22	1.46	-5.02	1.16	-3.61	0.51	-0.55
V) Control panel 2	0.88	7.54	-5.51	5.88	-5.51	3.13	-3.00	0.51	-0.58
T) Control panel 2	0.55	4.16	-4.01	3.14	-3.41	1.88	-2.15	0.35	-0.30
L) Control panel 2	0.87	3.43	-7.31	2.92	-6.25	1.72	-3.99	0.52	-0.65
V) Skid base 2	0.72	9.40	-3.47	4.20	-3.08	2.32	-2.36	0.53	-0.53
T) Skid base 2	0.45	3.79	-5.52	2.78	-3.29	1.53	-1.84	0.27	-0.26
L) Skid base 2	0.79	5.82	-5.36	2.87	-4.71	1.36	-3.80	0.45	-0.68
V) Engine mount 2	1.15	7.64	-8.18	5.92	-6.03	4.44	-3.35	0.90	-0.96
T) Engine mount 2	0.53	4.26	-3.73	3.88	-3.57	2.10	-1.63	0.26	-0.33
L) Engine mount 2	0.84	3.76	-4.83	3.53	-4.74	1.54	-3.82	0.53	-0.77

Time analyzed (seconds): 2.800 to 3.800

TABLE B-2.3-2. RAIL IMPACT AMPLITUDE DISTRIBUTION DATA

3-kW Generator Set Rail Impact Test  
Run No. 2: Forward - 6.3 mph

DESCRIPTION	RMS	+PEAK	-PEAK	+99.9%	-99.9%	+99%	-99%	+90%	-90%
V) Control panel 1	1.01	9.05	-5.60	6.28	-5.07	3.45	-2.92	0.92	-0.93
T) Control panel 1	0.51	2.37	-3.11	2.26	-2.60	1.41	-1.81	0.56	-0.45
L) Control panel 1	1.31	2.75	-9.07	2.47	-8.00	1.87	-6.34	0.90	-0.90
V) Skid base 1	0.99	12.62	-5.55	7.65	-4.93	3.14	-2.80	0.79	-0.90
T) Skid base 1	0.54	4.63	-6.41	2.76	-4.05	1.72	-1.60	0.45	-0.46
L) Skid base 1	1.37	3.76	-10.49	3.63	-9.56	1.95	-6.62	0.94	-0.70
V) Engine mount 1	0.89	5.04	-4.73	4.34	-4.36	2.49	-3.04	0.87	-0.82
T) Engine mount 1	0.28	1.49	-1.81	1.44	-1.81	0.89	-0.91	0.29	-0.26
L) Engine mount 1	1.28	2.04	-8.46	1.89	-7.46	1.74	-6.05	0.94	-0.82
V) Control panel 2	1.58	20.39	-9.17	14.86	-6.78	4.48	-4.00	1.01	-1.21
T) Control panel 2	0.90	7.28	-7.11	5.84	-6.23	3.06	-3.40	0.55	-0.57
L) Control panel 2	1.59	8.59	-10.15	6.23	-10.15	3.32	-7.42	1.02	-1.12
V) Skid base 2	1.39	14.18	-10.93	8.54	-7.41	4.35	-4.86	1.07	-1.05
T) Skid base 2	0.68	8.08	-4.07	4.64	-3.38	2.33	-2.41	0.47	-0.50
L) Skid base 2	1.43	10.68	-8.39	8.32	-8.39	2.46	-6.67	0.85	-1.19
V) Engine mount 2	1.69	8.02	-22.94	7.45	-14.48	5.54	-4.26	1.43	-1.20
T) Engine mount 2	0.93	9.86	-15.99	7.71	-8.81	2.79	-2.55	0.47	-0.45
L) Engine mount 2	1.51	6.58	-8.86	6.21	-8.81	3.16	-7.19	0.99	-1.60

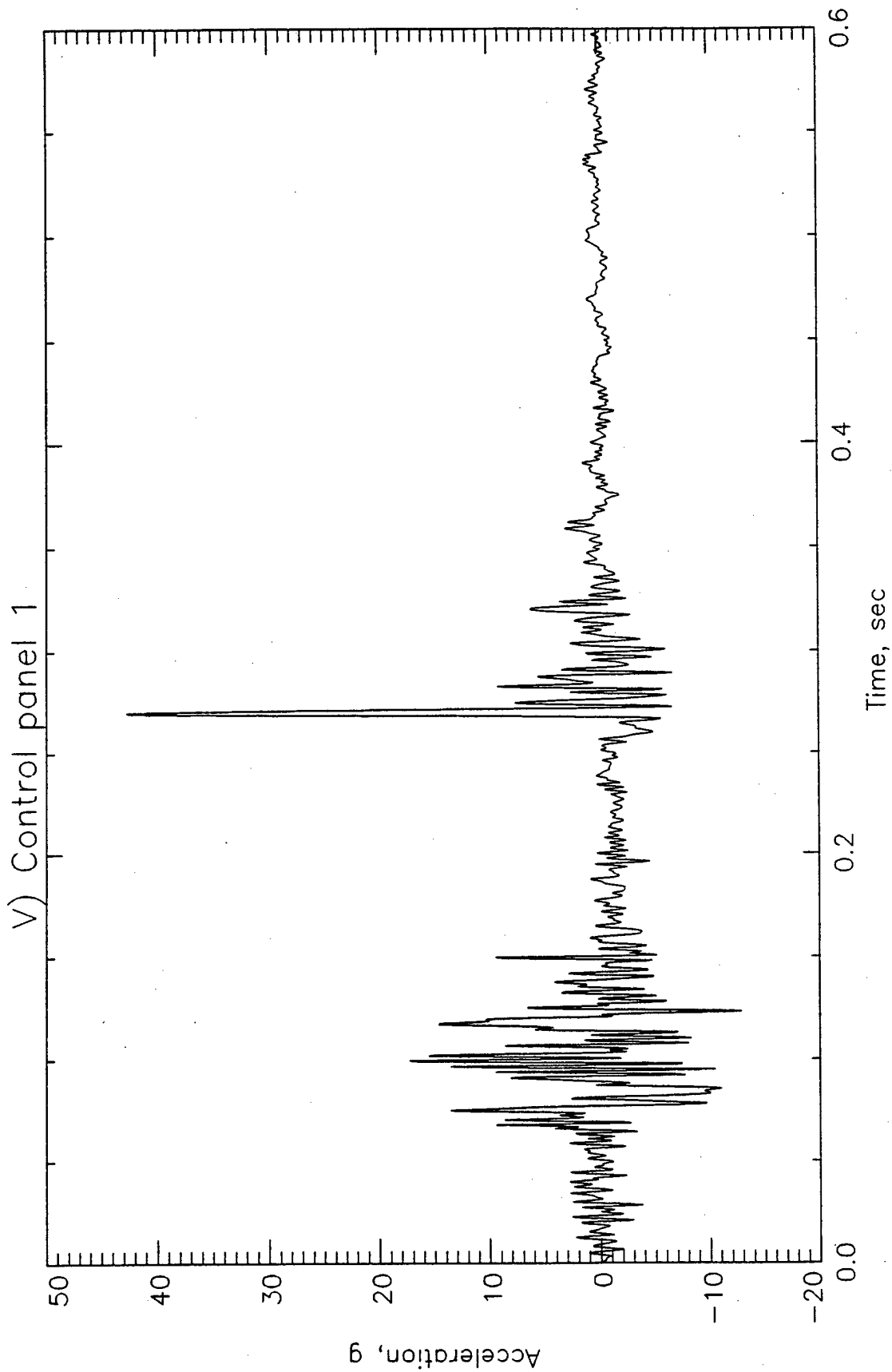
Time analyzed (seconds): 2.200 to 3.200

TABLE B-2.3-3. RAIL IMPACT AMPLITUDE DISTRIBUTION DATA

3-kW Generator Set Rail Impact Test  
Run No. 3: Forward - 8.3 mph

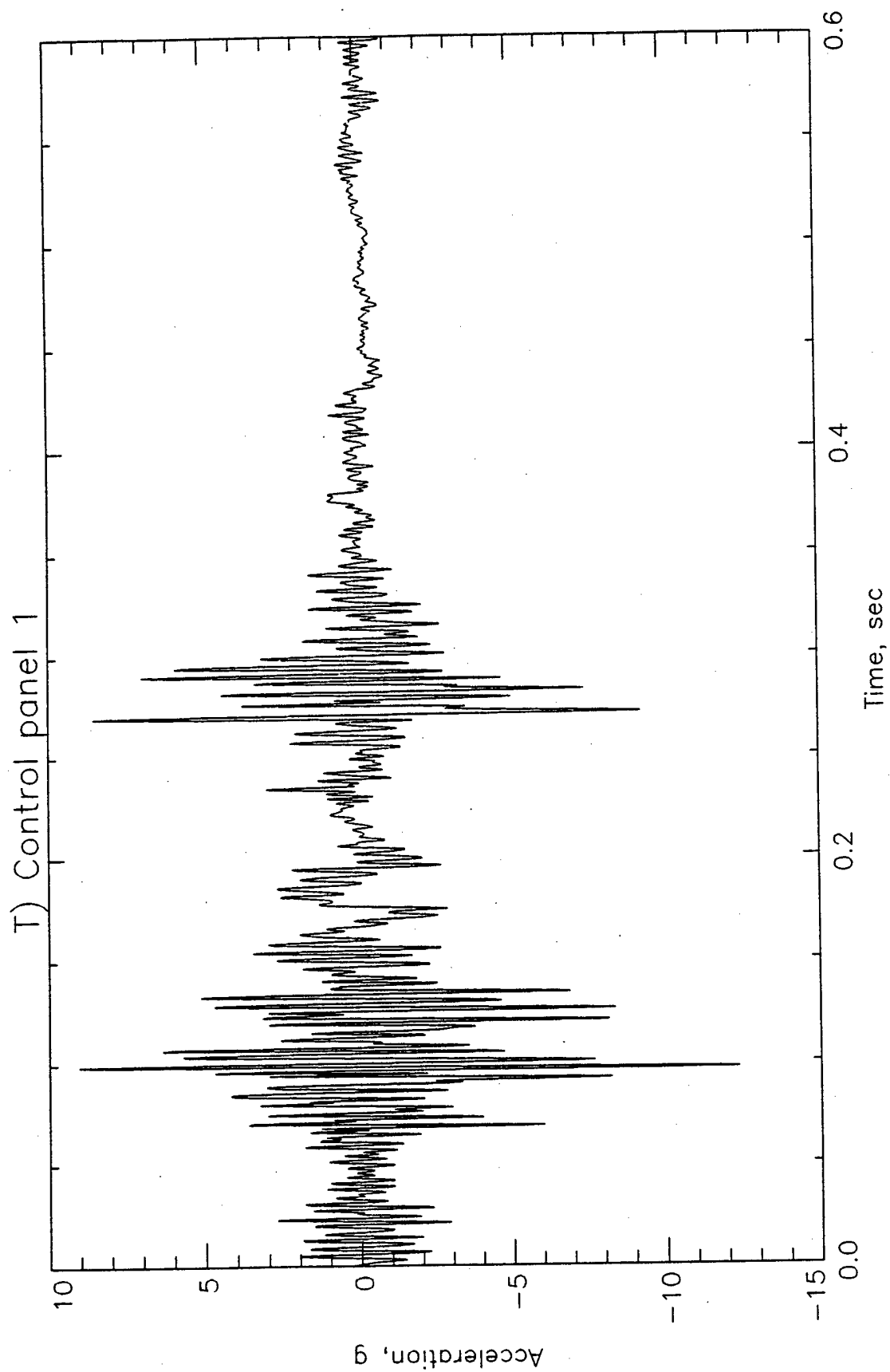
DESCRIPTION	RMS	+PEAK	-PEAK	+99.9%	-99.9%	+99%	-99%	+90%	-90%
V) Control panel 1	3.75	42.67	-12.83	42.67	-12.83	14.53	-8.89	2.02	-2.36
T) Control panel 1	1.72	9.10	-12.20	9.10	-12.20	5.43	-6.77	1.48	-1.52
L) Control panel 1	3.26	12.25	-26.57	12.25	-26.57	6.34	-14.39	1.77	-1.79
V) Skid base 1	3.84	37.16	-25.21	37.16	-25.21	16.96	-13.83	2.34	-2.62
L) Skid base 1	4.05	24.08	-37.15	24.08	-37.15	11.01	-18.41	1.72	-2.06
V) Engine mount 1	2.96	14.49	-21.15	14.49	-21.15	11.43	-8.84	2.77	-2.32
T) Engine mount 1	1.27	11.90	-5.74	11.90	-5.74	3.95	-3.69	0.75	-0.95
L) Engine mount 1	3.09	13.48	-27.08	13.48	-27.08	7.95	-14.06	1.67	-1.60
V) Control panel 2	3.18	27.61	-15.27	27.61	-15.27	12.83	-8.29	2.37	-2.47
T) Control panel 2	2.36	16.67	-18.19	16.67	-18.19	7.48	-8.67	1.82	-1.62
L) Control panel 2	3.63	18.84	-21.60	18.84	-21.60	9.23	-17.23	2.35	-2.38
V) Skid base 2	3.40	31.98	-24.85	31.98	-24.85	10.33	-8.80	2.48	-2.68
T) Skid base 2	2.45	16.73	-20.05	16.73	-20.05	8.22	-7.53	1.86	-1.90
L) Skid base 2	3.17	23.73	-20.61	23.73	-20.61	6.69	-13.94	2.18	-2.44
V) Engine mount 2	3.27	18.87	-22.89	18.87	-22.89	14.33	-7.46	2.96	-2.97
T) Engine mount 2	1.92	16.23	-14.92	16.23	-14.92	5.87	-5.90	1.82	-1.37
L) Engine mount 2	3.10	6.86	-19.71	6.86	-19.71	4.74	-15.00	2.20	-2.10

Time analyzed (seconds): 2.100 to 2.700



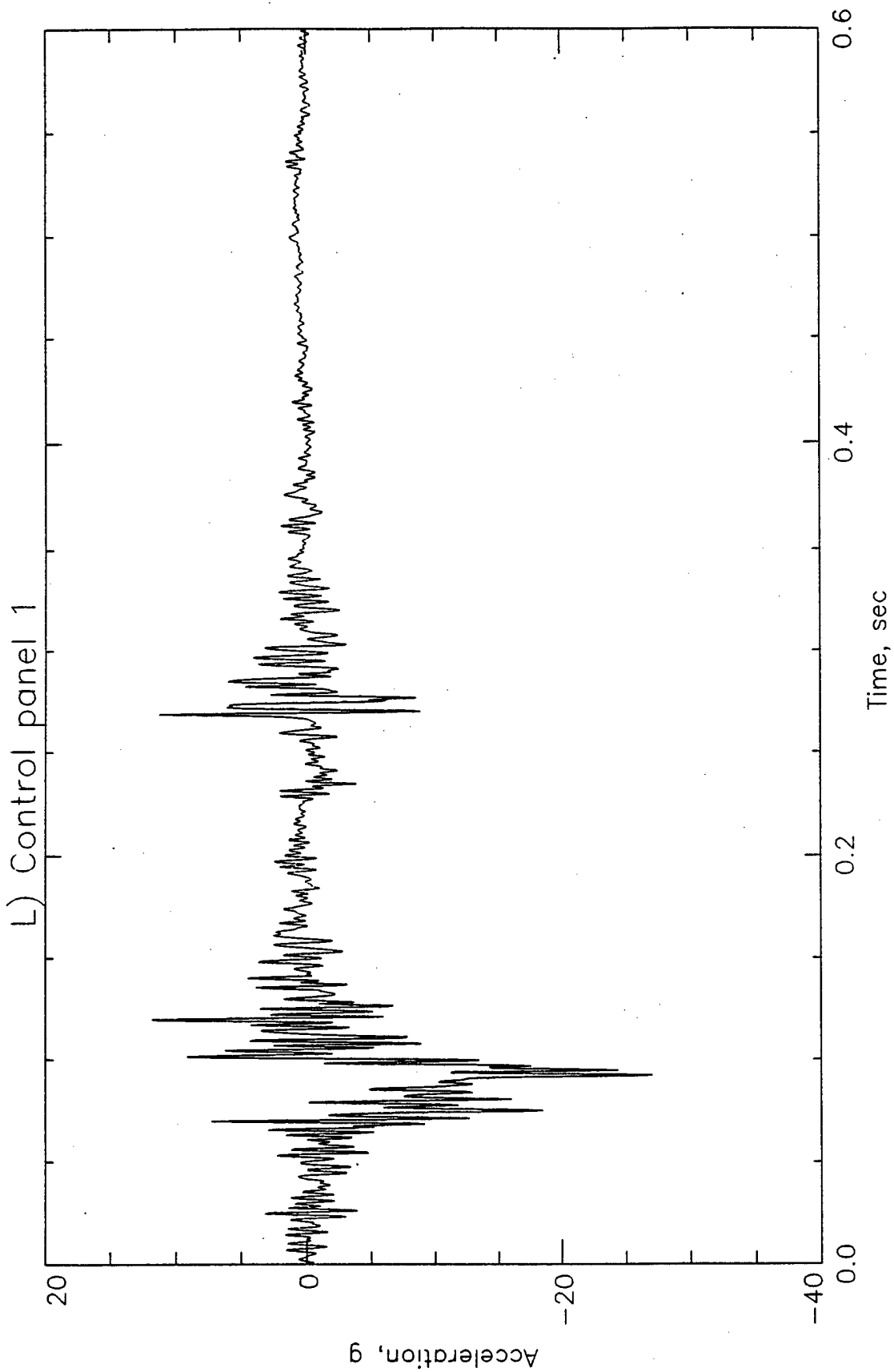
Generator set rail impact test - 3 kW  
Run 3: Forward - 8.3 mph

Figure B-2.3-17. Sample rail impact time history plot.



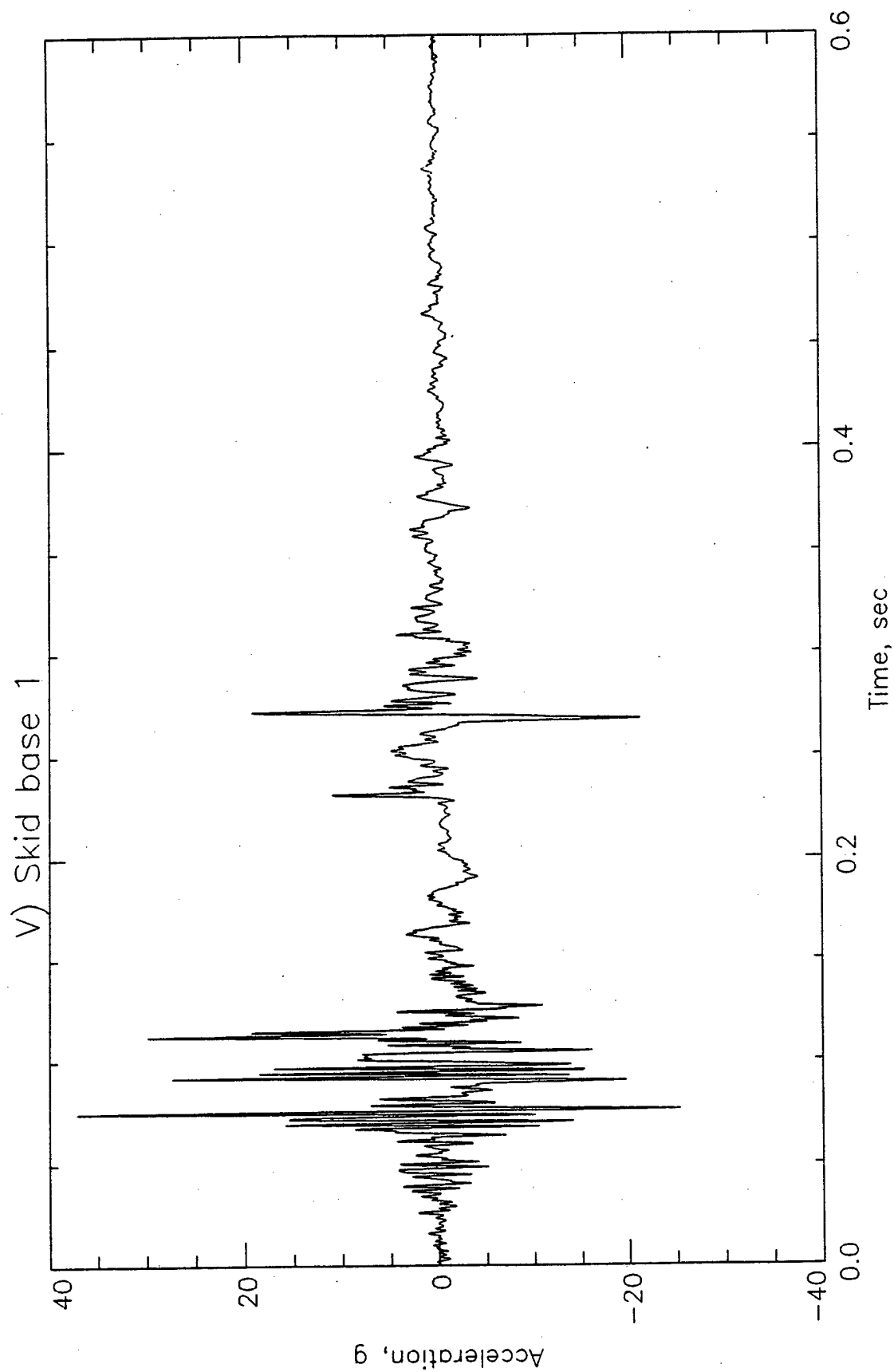
Generator set rail impact test - 3 kW  
Run 3: Forward - 8.3 mph

Figure B-2.3-18. Sample rail impact time history plot.



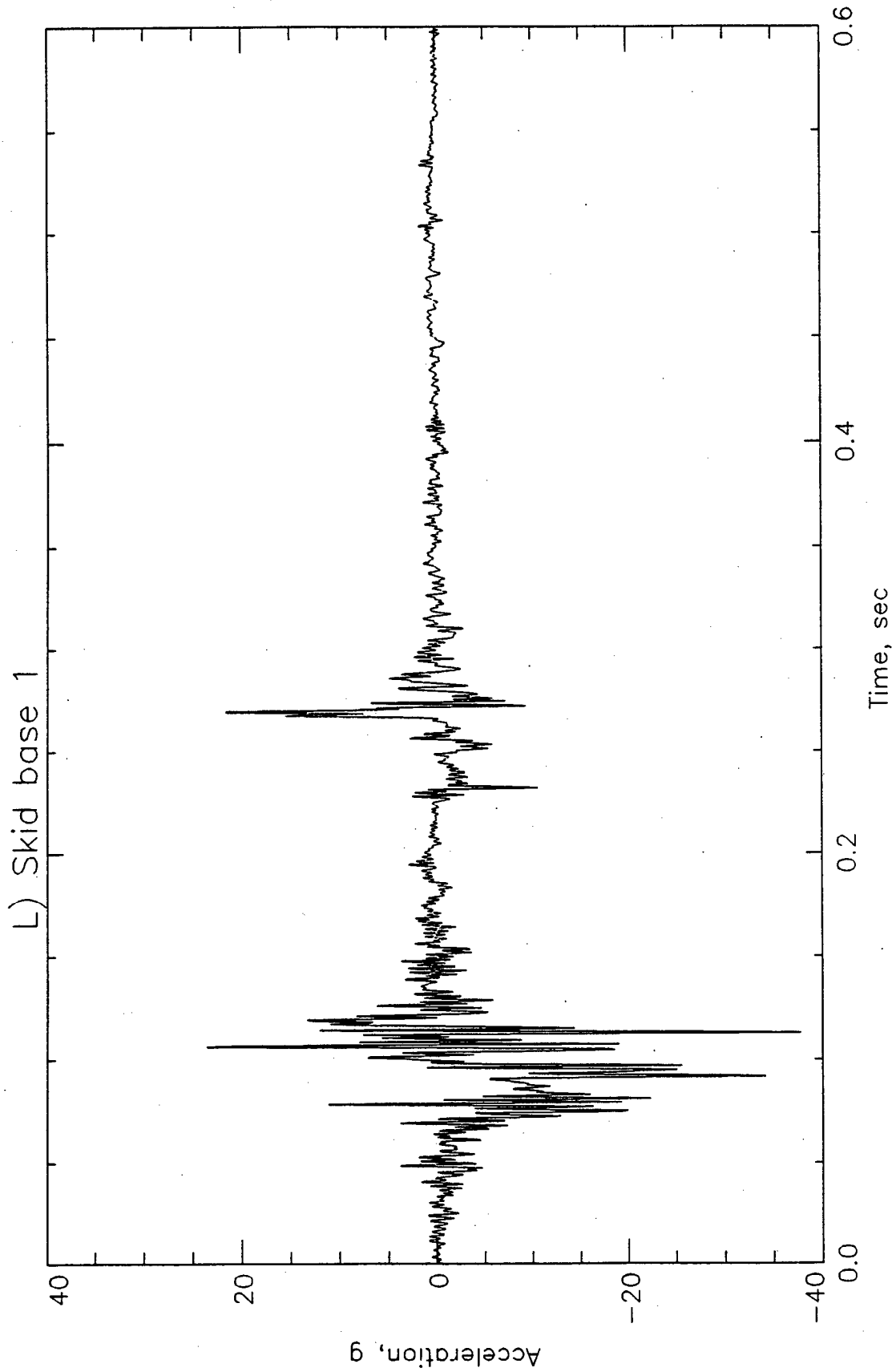
Generator set rail impact test - 3 kW  
Run 3: Forward - 8.3 mph

Figure B-2.3-19. Sample rail impact time history plot.



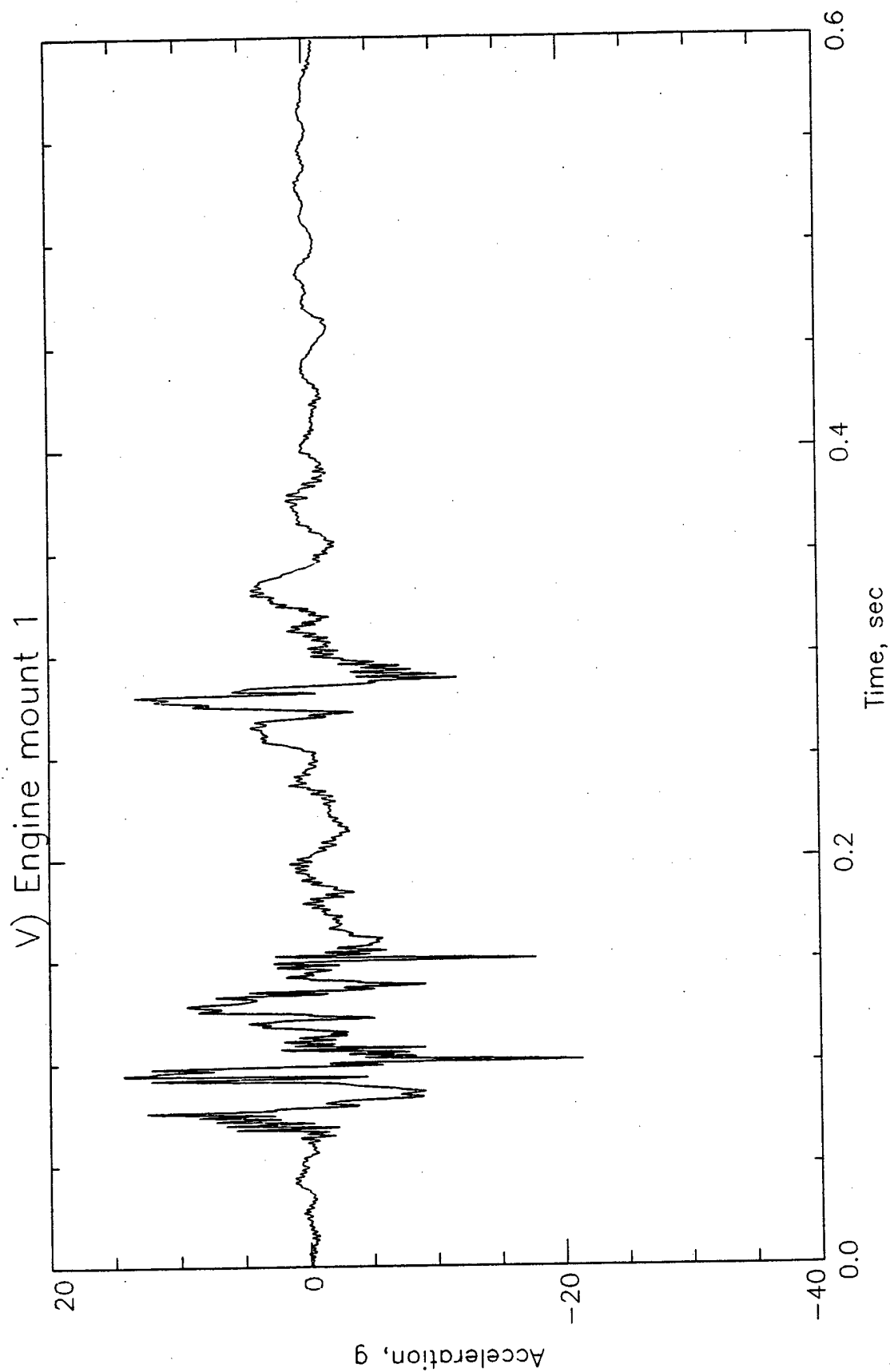
Generator set rail impact test - 3 kW  
Run 3: Forward - 8.3 mph

Figure B-2.3-20. Sample rail impact time history plot.



Generator set rail impact test - 3 kW  
Run 3: Forward - 8.3 mph

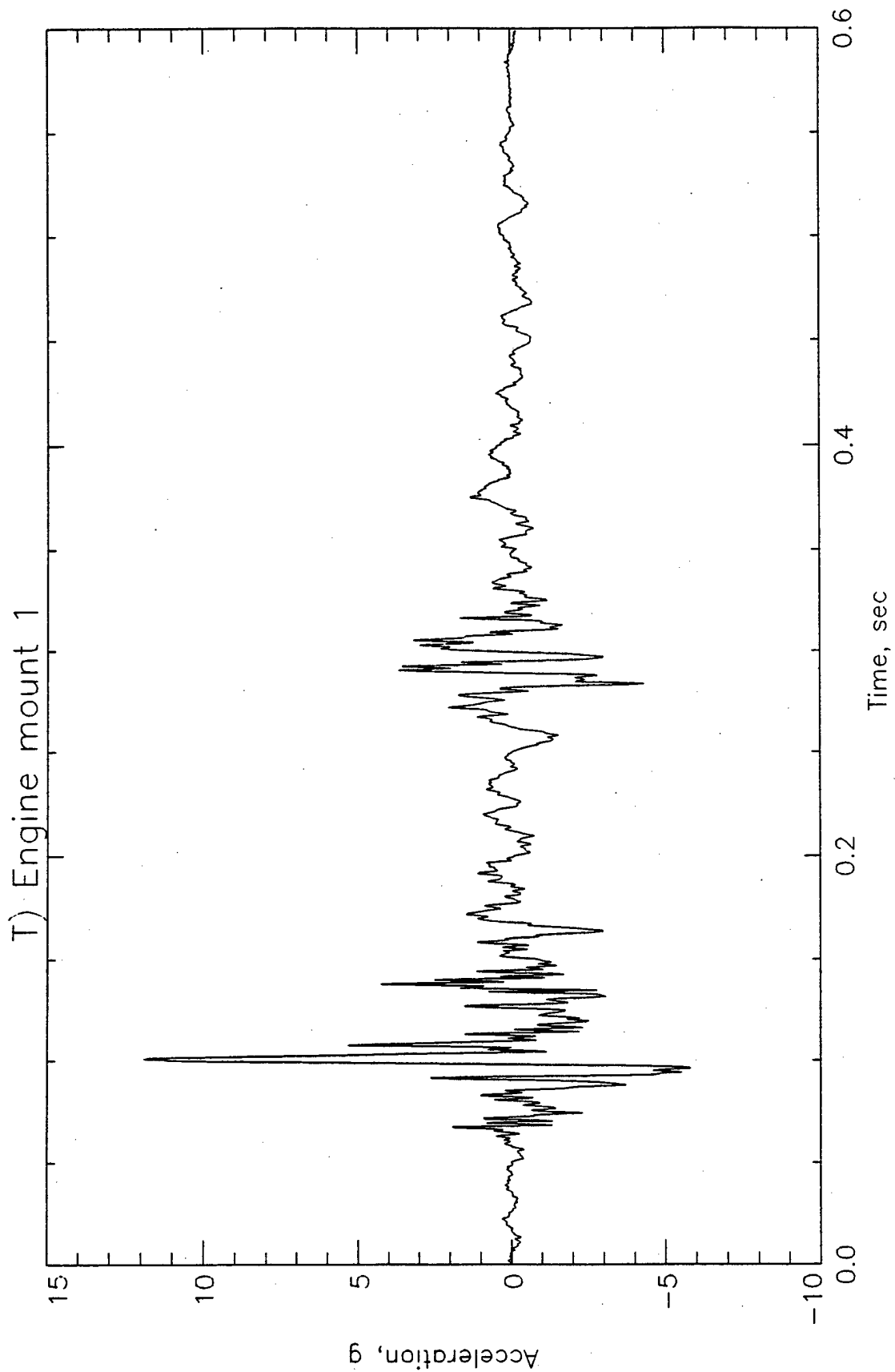
Figure B-2.3-21. Sample rail impact time history plot.



Generator set rail impact test - 3 kW  
Run 3: Forward - 8.3 mph

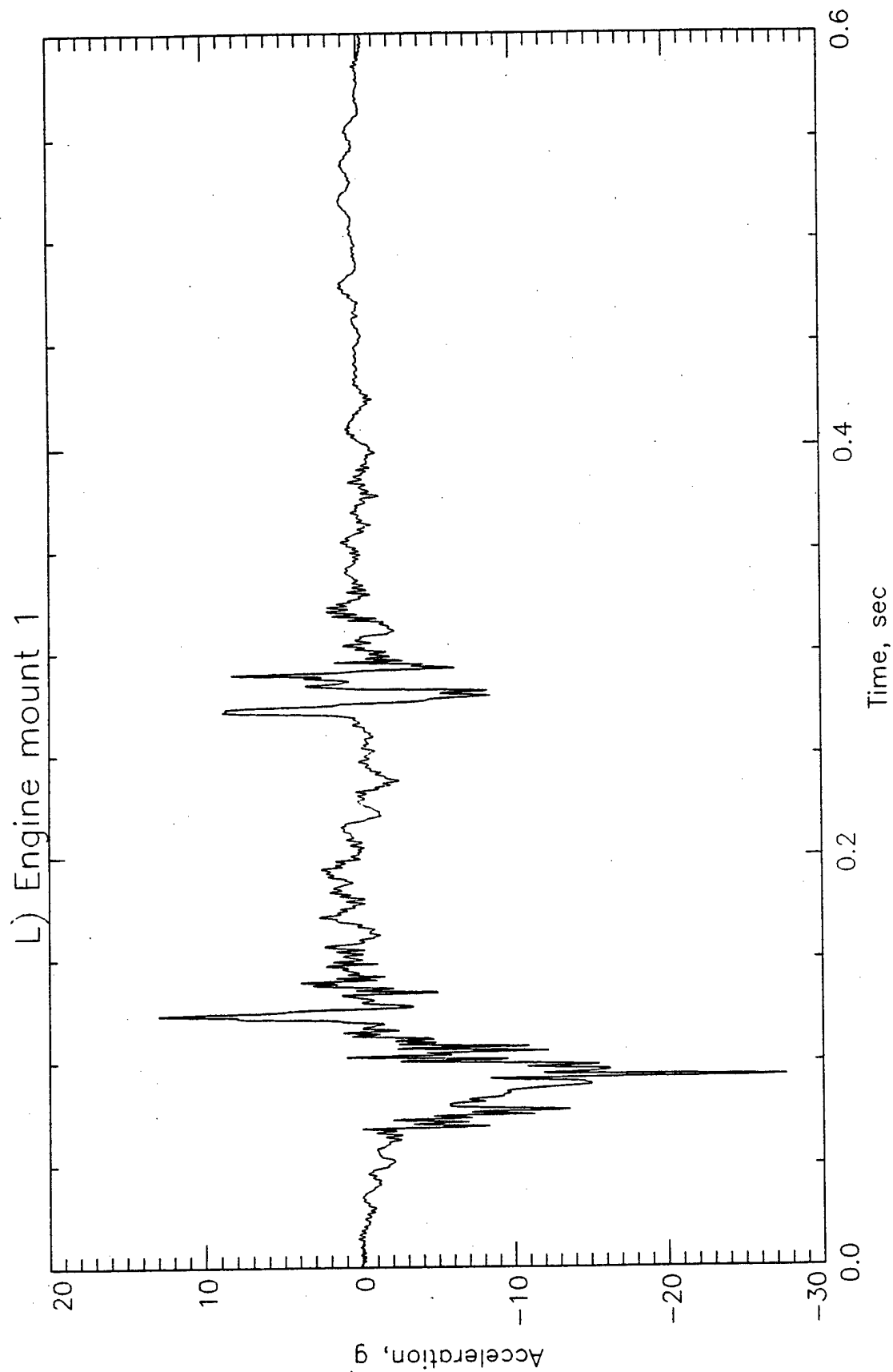
Figure B-2.3-22. Sample rail impact time history plot.





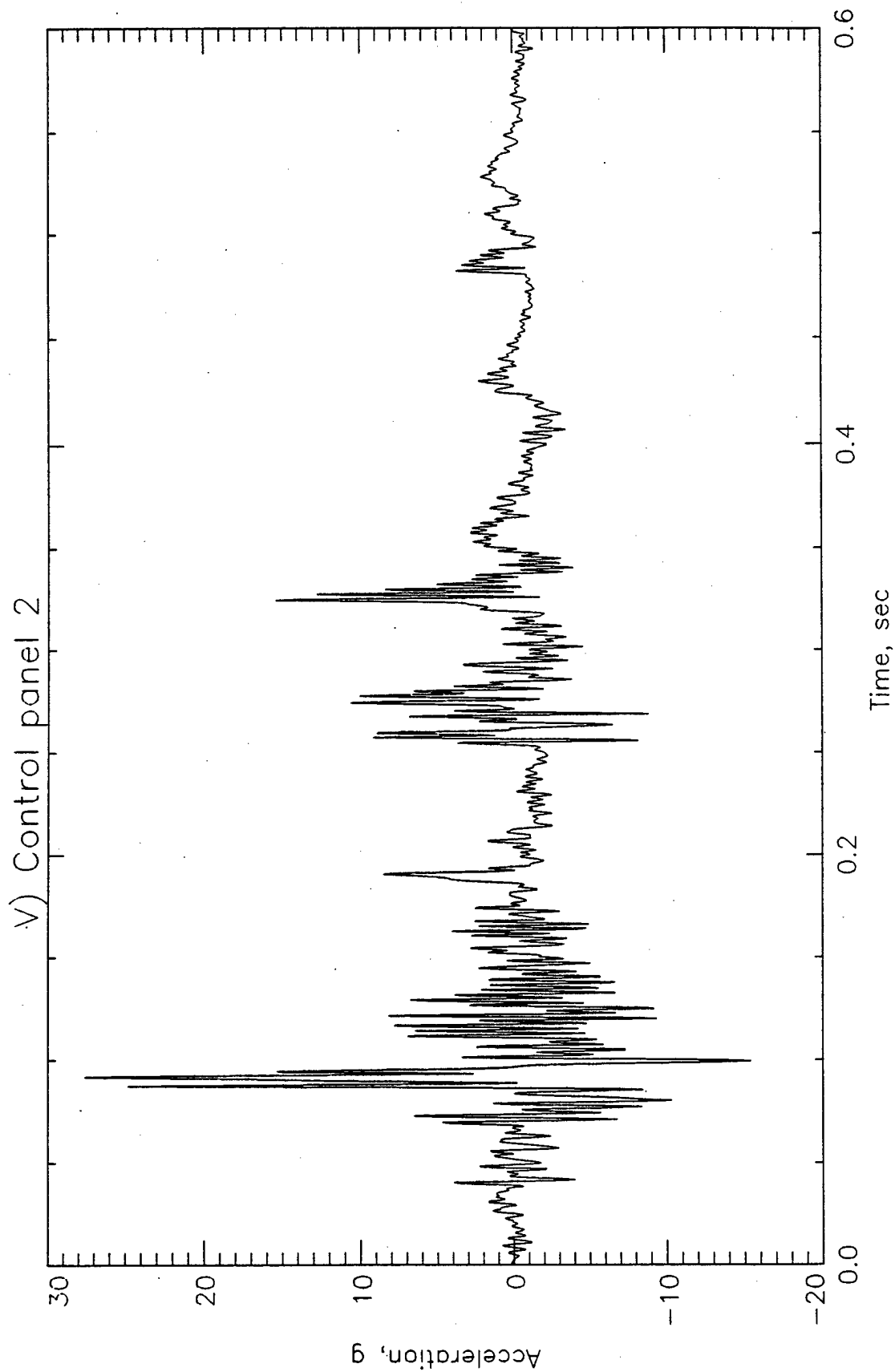
Generator set rail impact test - 3 kW  
Run 3: Forward - 8.3 mph

Figure B-2.3-23. Sample rail impact time history plot.



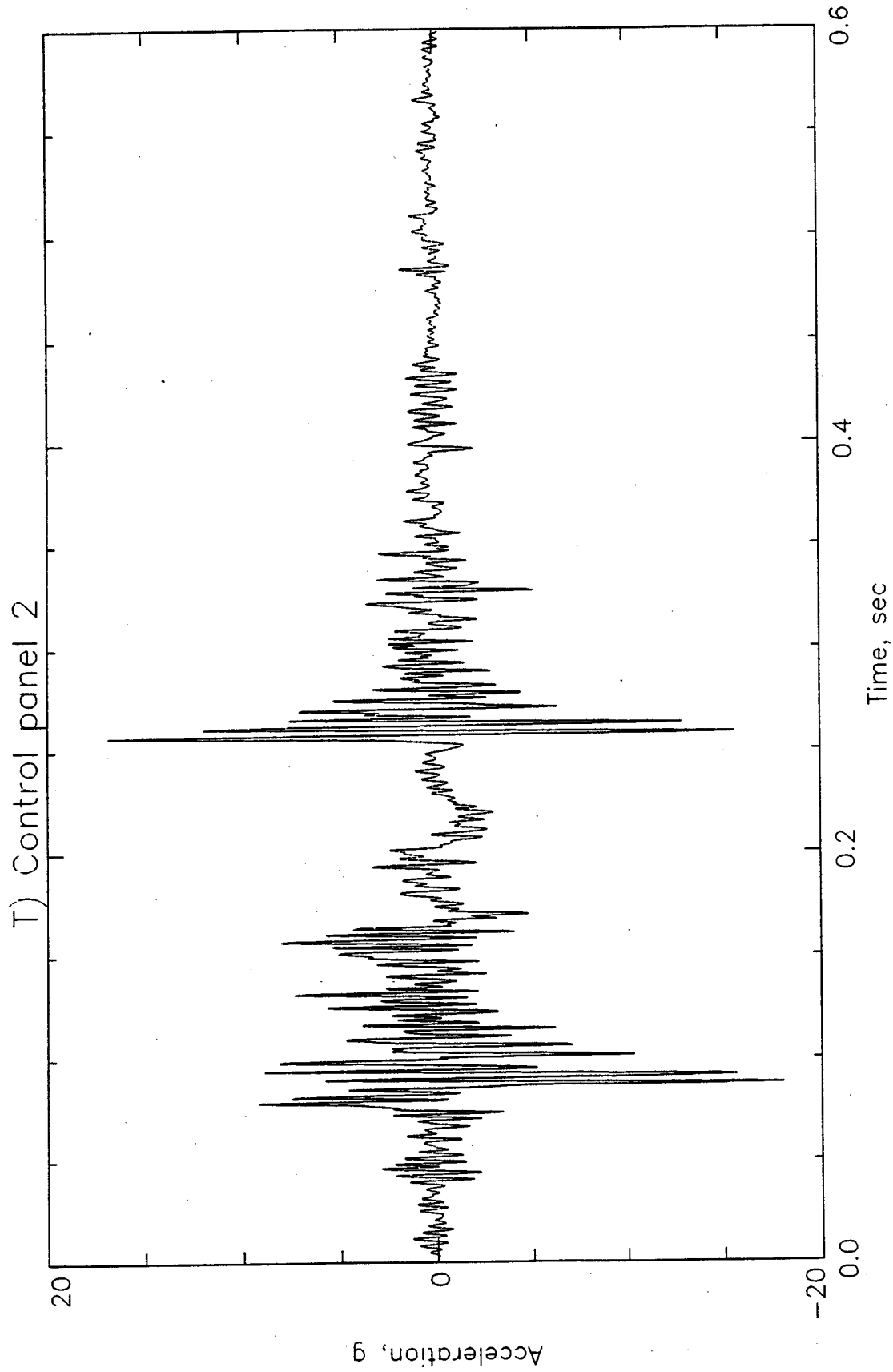
Generator set rail impact test - 3 kW  
Run 3: Forward - 8.3 mph

Figure B-2.3-24. Sample rail impact time history plot.



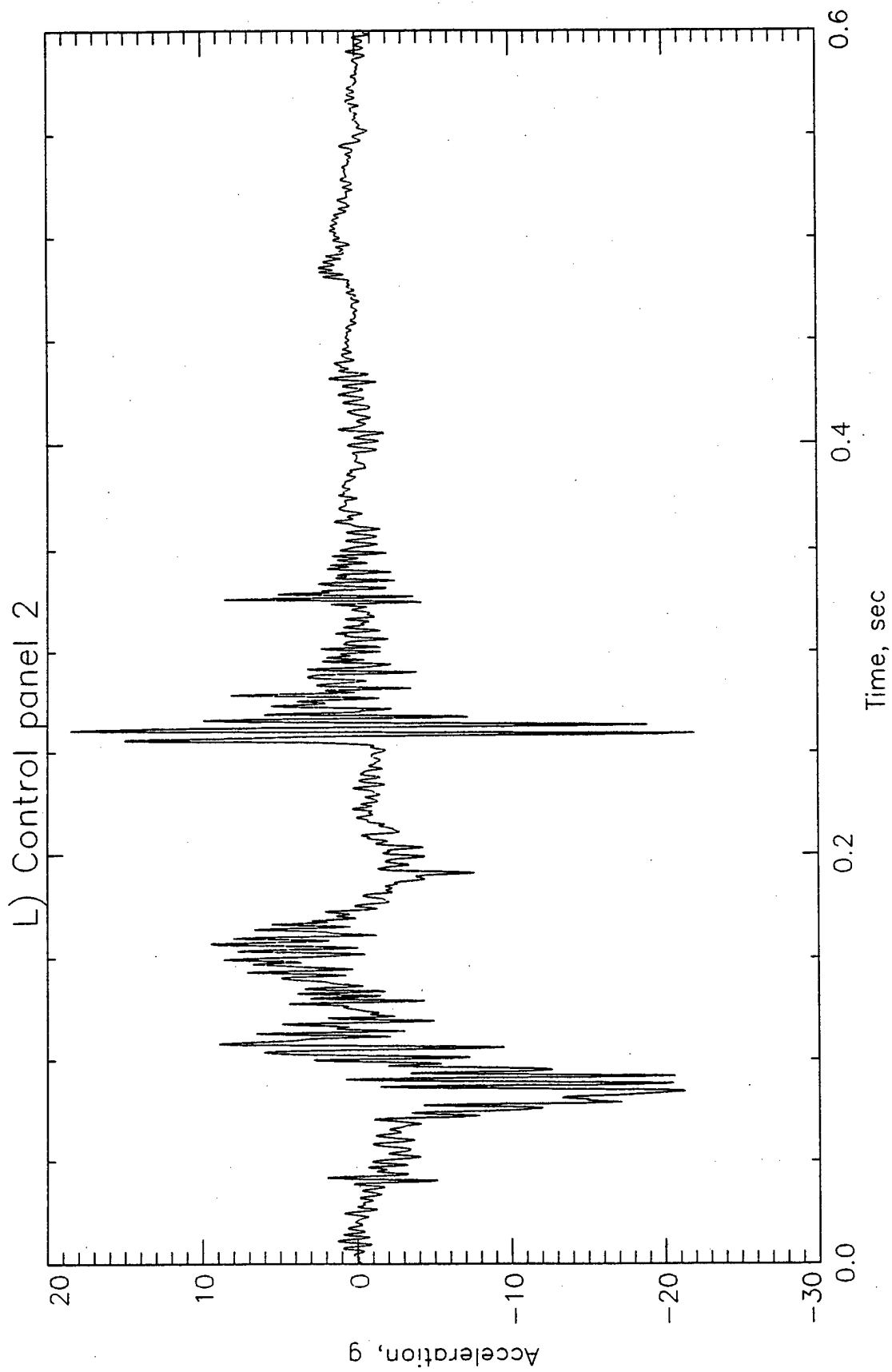
Generator set rail impact test - 3 kW  
Run 3: Forward - 8.3 mph

Figure B-2.3-25. Sample rail impact time history plot.



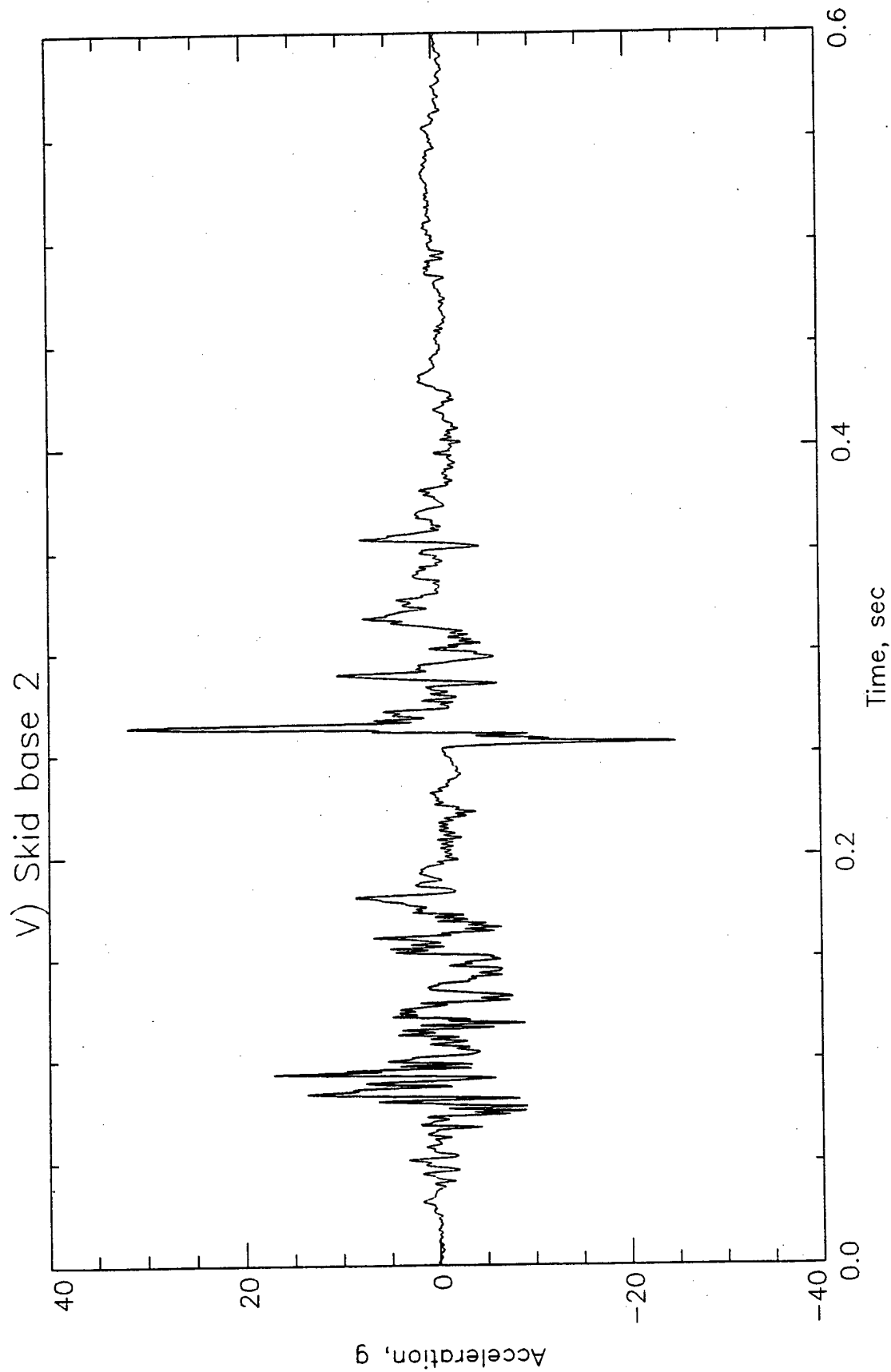
Generator set rail impact test - 3 kW  
Run 3: Forward - 8.3 mph

Figure B-2.3-26. Sample rail impact time history plot.



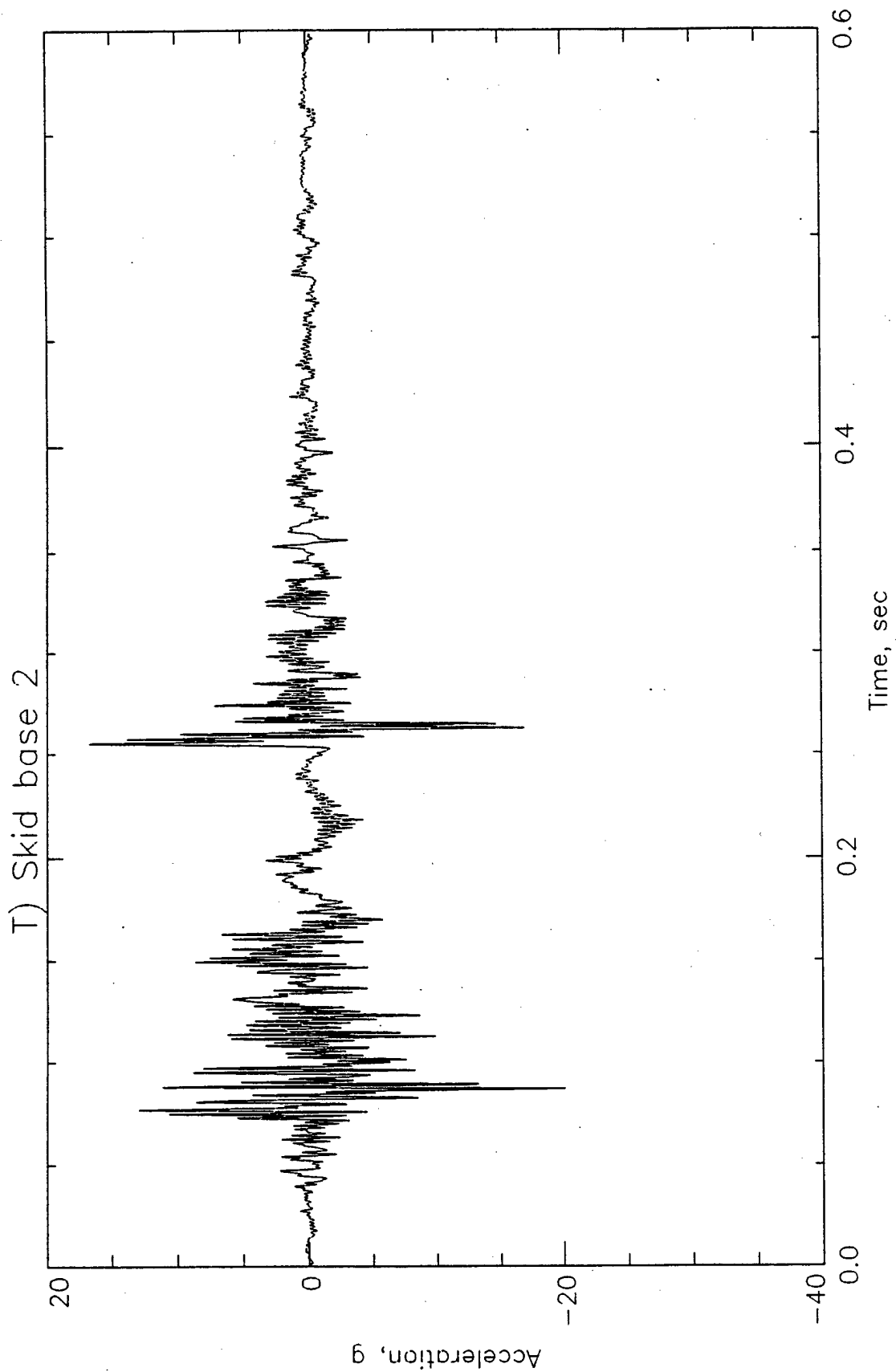
Generator set rail impact test - 3 kW  
Run 3: Forward - 8.3 mph

Figure B-2.3-27. Sample rail impact time history plot.



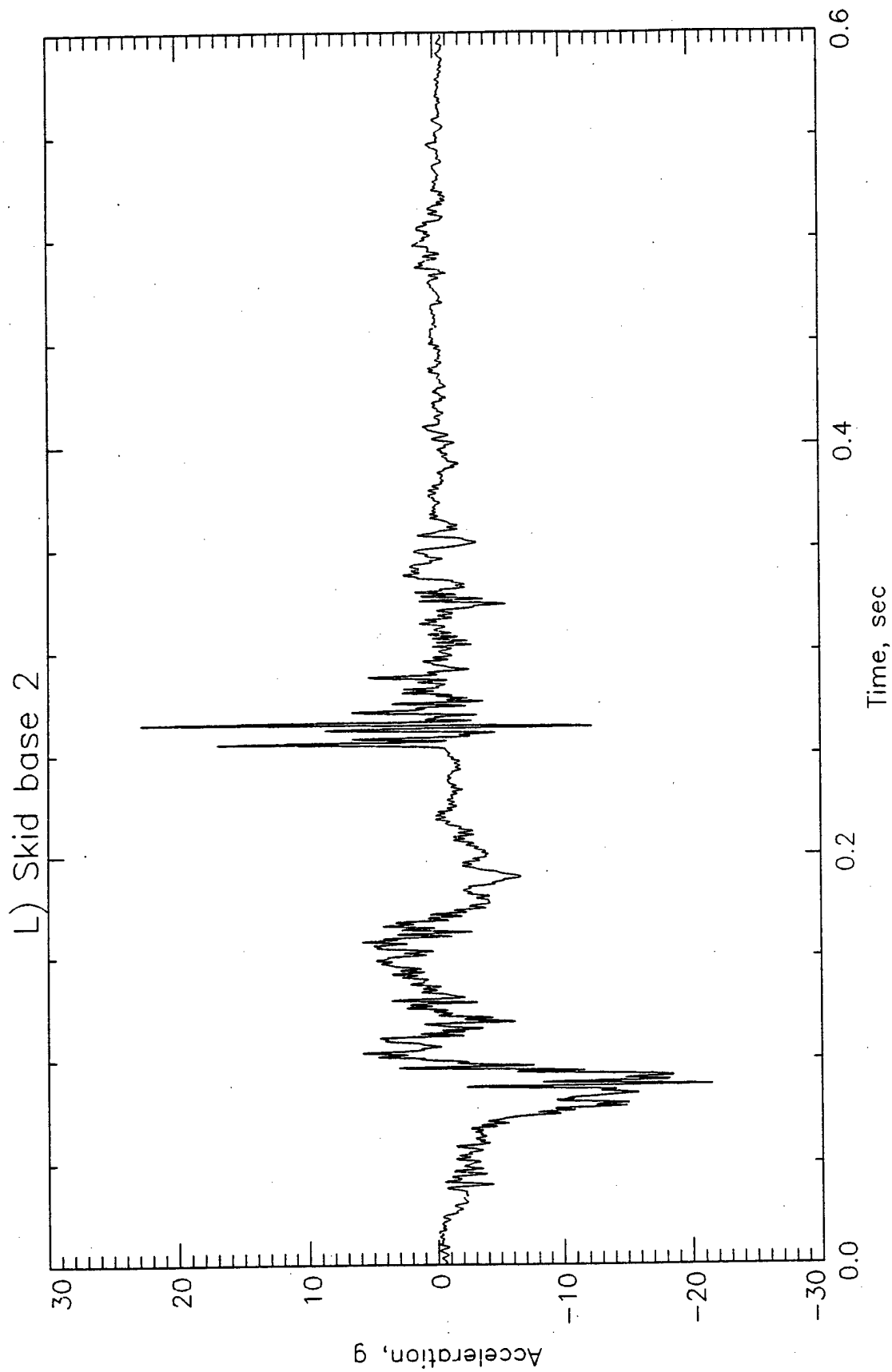
Generator set rail impact test - 3 kW  
Run 3: Forward - 8.3 mph

Figure B-2.3-28. Sample rail impact time history plot.



Generator set rail impact test - 3 kW  
Run 3: Forward - 8.3 mph

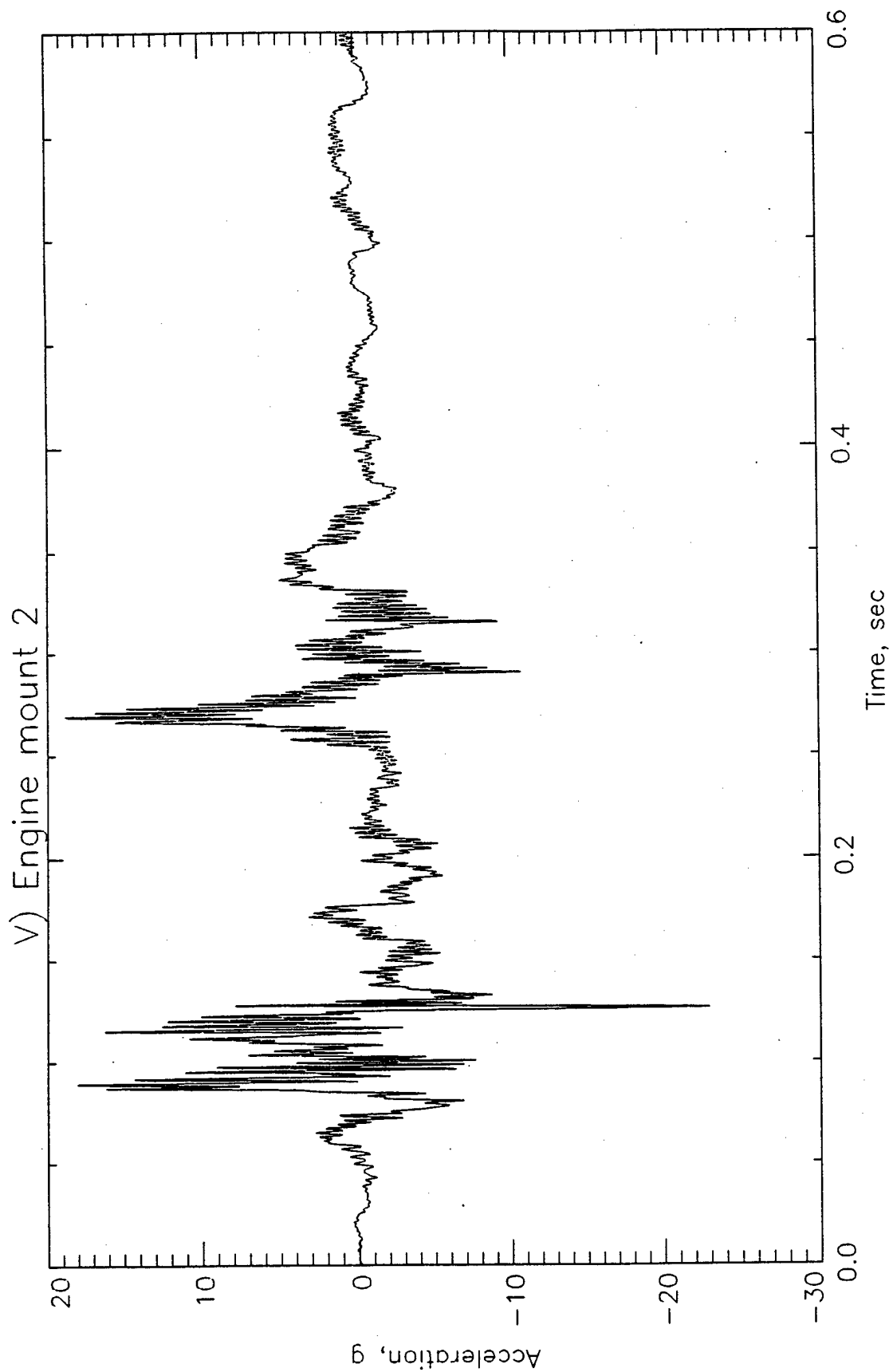
Figure B-2.3-29. Sample rail impact time history plot.



Generator set rail impact test - 3 kW  
Run 3: Forward - 8.3 mph

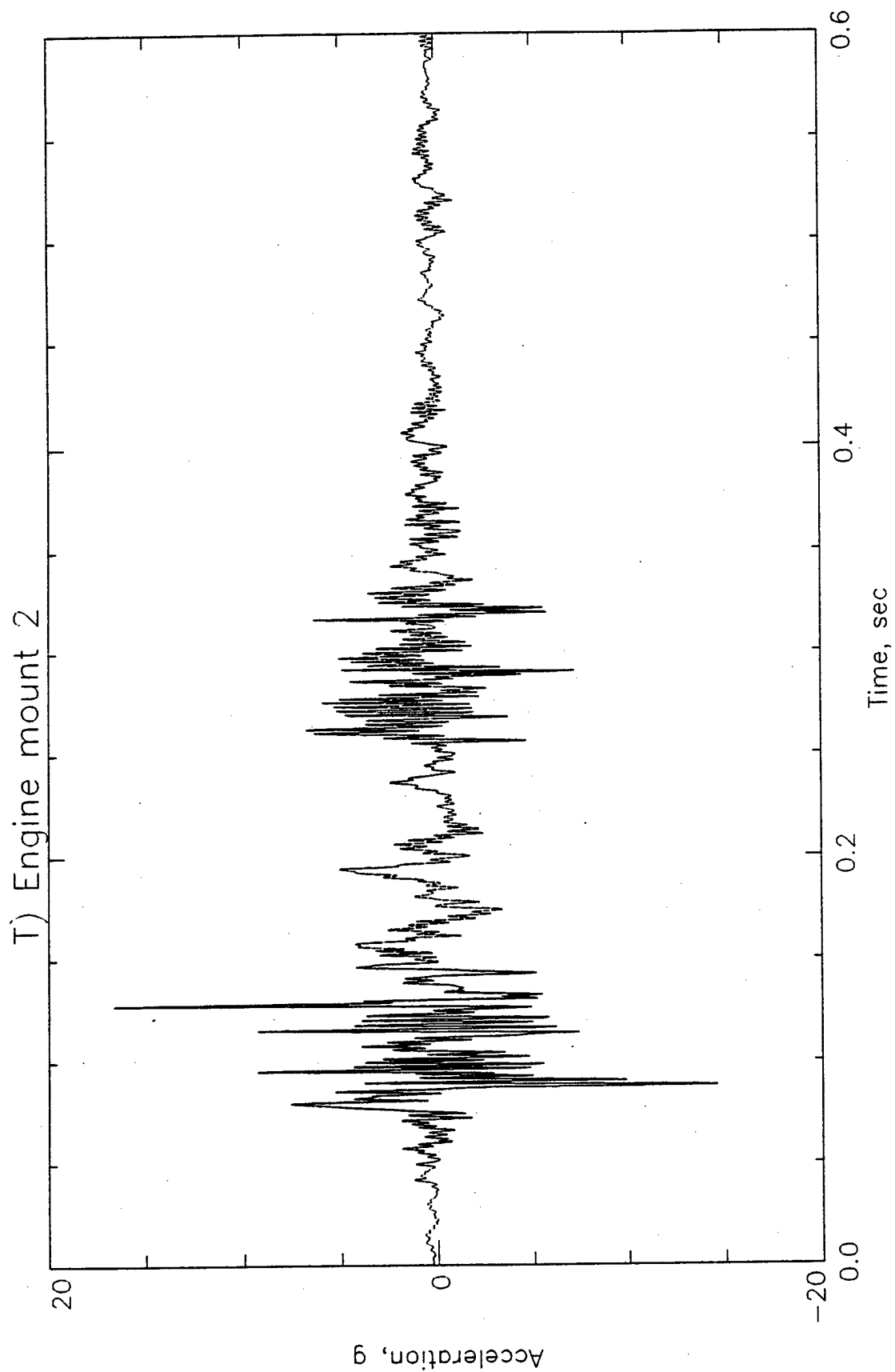
Figure B-2.3-30. Sample rail impact time history plot.





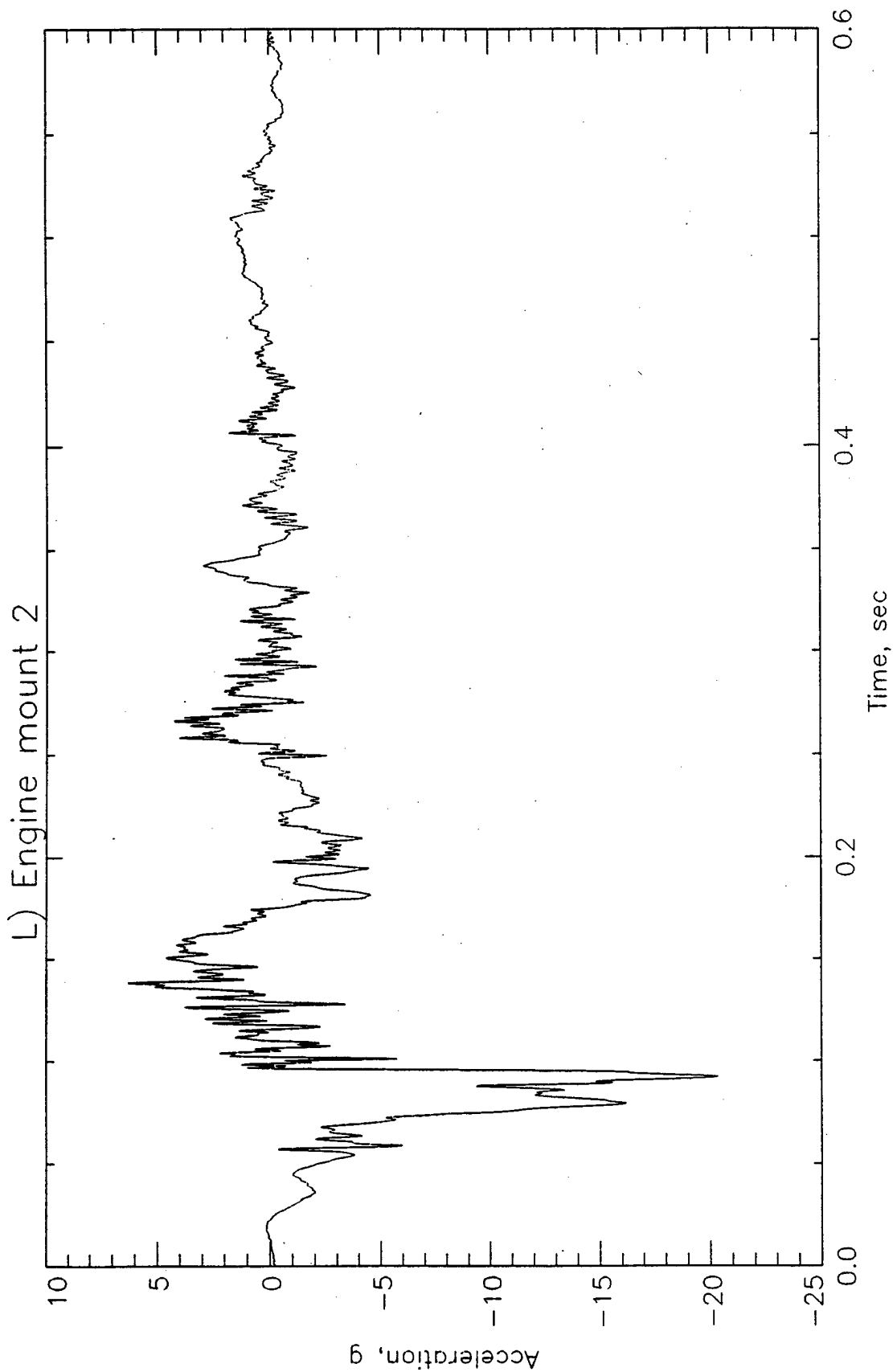
Generator set rail impact test - 3 kW  
Run 3: Forward - 8.3 mph

Figure B-2.3-31. Sample rail impact time history plot.



Generator set rail impact test - 3 kW  
Run 3: Forward - 8.3 mph

Figure B-2.3-32. Sample rail impact time history plot.



Generator set rail impact test - 3 kW  
Run 3: Forward - 8.3 mph

Figure B-2.3-33. Sample rail impact time history plot.

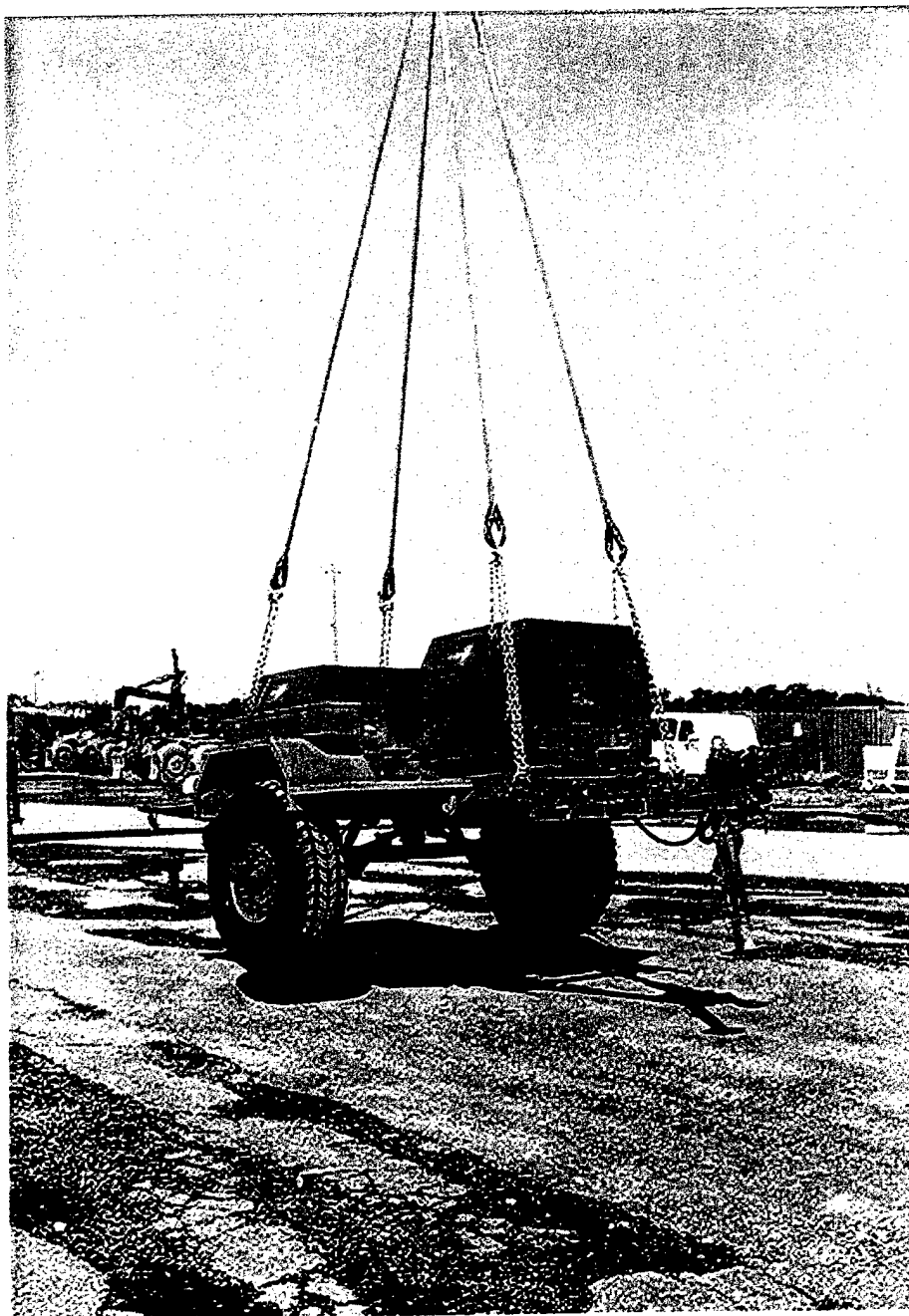


Figure B-2.5-1. Power Plant at desired attitude.

B-2.5-1

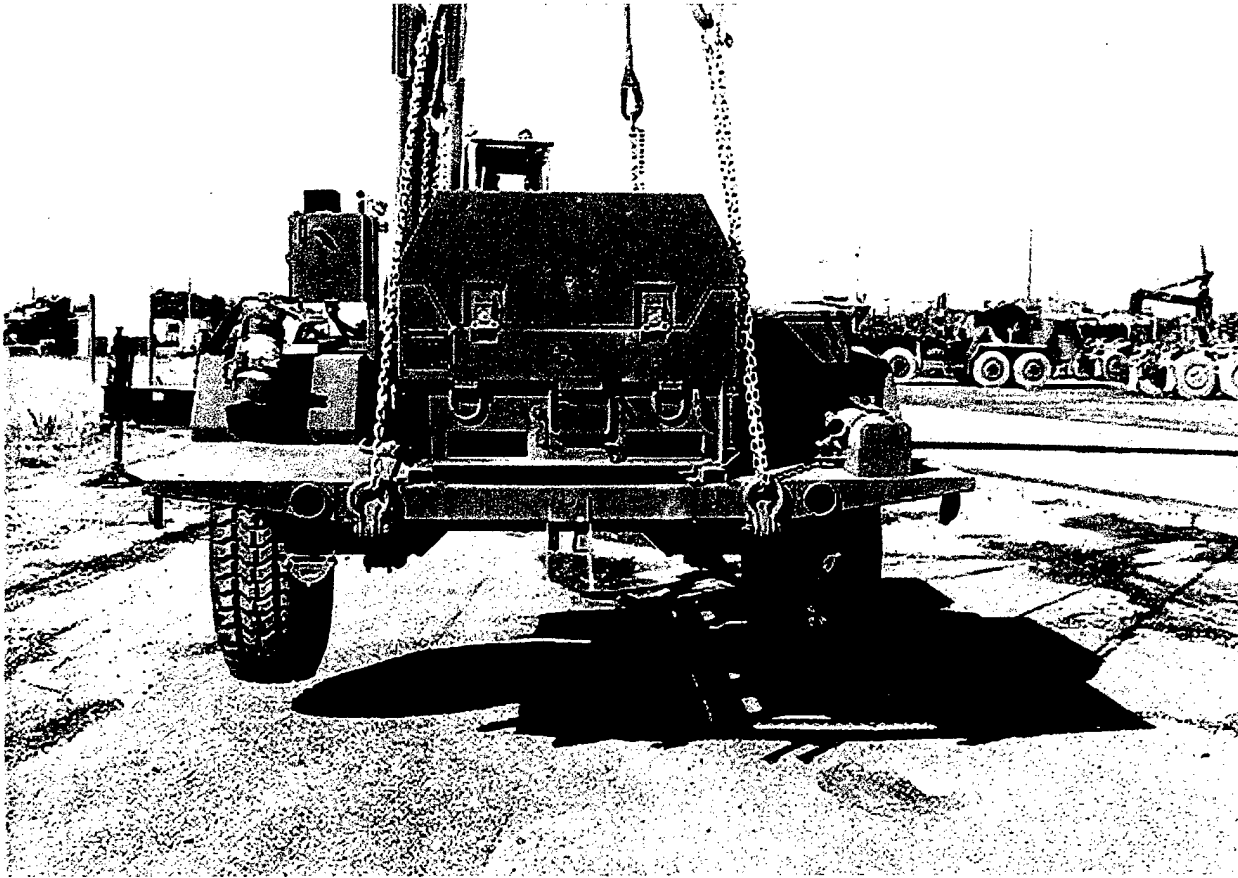


Figure B-2.5-2. Chains contacting sides of generator set.

## APPENDIX C. REFERENCES

1. Memorandum, TECOM, AMSTE-TM-S, 10 July 1998, subject: Test Execution Directive for Production Qualification Test (PQT) of the 3-kW Tactical Quiet Generator Set (TQG), TECOM Project No. 8-EG-335-ECG-021.
2. Purchase Description, Generator Sets, Diesel-Fueled, Skid-Mounted, Lightweight, Tactical, Quiet, 3-kW, updated through P00011, 6 March 1998.
3. Detailed Test Plan, First Article Test (FAT) of the 3-kW Tactical Quiet Generator (TQG) Sets, March 1999.
4. MIL-STD-705C, Generator Sets, Engine Driven, Methods of Test and Instructions, 24 April 1989.
5. MIL-M-63036A (TM), Manuals, Technical: Operator's Preparation of, 1 April 1980.
6. MIL-STD-1472E, Department of Defense Design Criteria Standard, Human Engineering, 31 October 1996.
7. Required Operational Capability (ROC) for the Commercial Generator Sets and Assemblages, 22 February 1988.
8. TOP 1-2-609, Instructional Material Adequacy Guide and Evaluation Standard (IMAGES), 1 January 1981.
9. Association of American Railroads, Section 6, Rules Governing the Loading of DOD Materials on Open Top Cars, 1 September 1988.
10. MIL-STD-913A, Requirements for the Certification of Sling Loaded Military Equipment for External Transportation by Department of Defense Helicopters, 3 February 1997.
11. MIL-STD-2160, High-Altitude Electromagnetic Pulse (HAEMP) Environment.
12. MIL-STD-882C, System Safety Program Requirements, 19 January 1993.
13. MIL-HDBK-454, Military Handbook, General Guidelines for Electronic Equipment, Guideline 1 - Safety Design Criteria - Personnel Hazards, 28 April 1995.
14. MIL-HDBK-705C, Military Standardization Handbook, Generator Sets, Electrical, Measurements and Instrumentations, 29 May 1987.
15. AMC Regulation 700-15, TECOM Supplement 1, Integrated Logistics Support (ILS), 30 September 1991.

16. AMC Pamphlet 706-134, Engineering Design Handbook, Maintainability Guide for Design, 3 October 1972.
17. MIL-M-38784B, Manuals, Technical: General Style and Format Requirements, 16 April 1983.
18. MIL-M-63000C(1), Manual, Technical, General Requirements for Manuscripts, 2 August 1971.
19. TM 9-6115-638-14, 3-kW Tactical Quiet Generator (TQG) Set MEP 831A (60-Hz) and MEP 832A (400-Hz), NSN: TBD, 15 January 1999.
20. MIL-DTL-0053133A (ME), Detail Specification Sheet, Generator Sets, Skid Mounted, Tactical, Quiet, Diesel Engine Driven, Alternating Current, 5 Through 60 Kilowatts, General Specification for, 24 July 1995.
21. MIL-STD-810E, Environmental Test Methods and Engineering Guidelines, 14 July 1989.
22. TOP 2-2-801, Weight Distribution and Ground Pressure, 7 August 1981.
23. AR 700-127, Integrated Logistics Support, 1 March 1988, with Change 1, 1 April 1988.
24. MIL-STD-882B, System Safety Program Requirements, 30 March 1984.
25. TOP 1-1-012, Classification of Deficiencies and Shortcomings, 1 April 1979, with Changes 1 and 2.
26. A-A-52557, Fuel Oil, Diesel; for Posts, Camps, and Stations, 2 January 1996.
27. MIL-F-46162, Fuel, Diesel, Referee Grade, Amendment 1, 17 March 1993.
28. MIL-T-83133A, Turbine Fuel, Aviation, Kerosene Types, NATO F-34 (JP-8) and NATO F-35, Amendment 1, 19 September 1995.
29. MIL-STD-1474D, Department of Defense Design Criteria Standard, Noise Limits, 12 February 1997.
30. MIL-STD-209H, Slings and Tie-Down Provisions for Lifting and Tying Down Military Equipment, 28 June 1991.
31. TOP 2-2-800, Center of Gravity, 31 December 1993.
32. MIL-DTL-0053133/7A (ME), Detail Specification Sheet, Generator Sets, Skid Mounted, Tactical, Quiet, Diesel Engine Driven, Alternating Current, 30 Kilowatts, 60 Hertz, 24 July 1995.

33. MIL-DTL-0053133/8A (ME), Detail Specification Sheet, Generator Sets, Skid Mounted, Tactical, Quiet, Diesel Engine Driven, Alternating Current, 30 Kilowatts, 400 Hertz, 24 July 1995.
34. MIL-DTL-0053133/9A (ME), Detail Specification Sheet, Generator Sets, Skid Mounted, Tactical, Quiet, Diesel Engine Driven, Alternating Current, 60 Kilowatts, 60 Hertz, 24 July 1995.
35. MIL-DTL-0053133/10A (ME), Detail Specification Sheet, Generator Sets, Skid Mounted, Tactical, Quiet, Diesel Engine Driven, Alternating Current, 60 Kilowatts, 400 Hertz, 24 July 1995.
36. Test and Evaluation Master Plan (TEMP III) for 5- through 60-kW Tactical Quiet Generator (TQG) Sets, 25 June 1992.
37. Military Specification, Power Unit, Electrical, Diesel Engine Driven, Trailer Mounted,
38. Andrese, Joseph A., Independent Assessment Plan (IAP) for the Initial Production Test (IPT) of the Commercial Generator Set Assemblies (CGSAs).
39. Antonetti, Jose, Detailed Test Plan, Production Verification Test (PVT) of the 5- to 60-kW Tactical Quiet Generator (TQG) Sets, September 1997.
40. MIL-STD-461D, Military Standard Requirement for the Control of Electromagnetic Interference Emissions and Susceptibility, 11 January 1993.
41. MIL-STD-462D, Military Standard Measurement of Electromagnetic Interference Characteristics, 11 January 1993.
42. DACOM Regulation 70-13, Test and Evaluation Incidents Disclosed during Materiel Testing, 16 August 1982.
43. TOP 10-2-508, Safety and Health Hazard Evaluation - General Equipment, 6 May 1980.
44. MTP 9-2-286, Power Generators, 25 March 1970.
45. MIL-STD-633F (Proposed), Mobile Electric Power, Standard Family of Mobile Electric Power Generating Sources, General Description Information and General Characteristics, 16 June 1997.
46. MIL-STD-1332B, Definitions of Tactical, Prime, Precise, and Utility Terminologies for Classification of the DOD Mobile Electric Power Engine Generator Set Family, 13 March 1973.



47. MIL-STD-781C, Reliability Design Qualification and Production Acceptance Tests: Exponential Distribution, 21 October 1977.
48. VV-F-800D, Fuel Oil, Diesel, Referee Grade, 1 October 1993.
49. MIL-PRF-5624S, Turbine Fuel, Aviation, Grades JP-4, JP-5, and JP-5/JP-8 ST, 22 November 1996.
50. Antonetti, Jose, Detailed Test Plan, Foreign Comparative Test (FCT) of the Less-Than-3-Kilowatt (LT3KW) Generator Sets, 3 kW, April 1995.
51. Graham, Dennis, Detailed Test Plan, Production Qualification Test (PQT) of Tactical Quiet Generator (TQG) Sets, 5, 10, 15, 30, and 60 kW, February 1993.
52. Graham, Dennis, Detailed Test Plan, First Article Test (FAT) of Tactical Quiet Generator (TQG) Sets, 5, 10, 15, 30, and 60 kW, December 1989.
53. TOP 9-2-286, Power Generators, 19 April 1994.
54. DARCOM Regulation 700-15, Integrated Logistics Support (ILS), 26 November 1979. 5-kW through 100-kW, 6 January 1989.

## APPENDIX D. ABBREVIATIONS

AAR	=	Association of American Railroads
AC	=	alternating current
ADACS	=	Automated Data Collection System
ADOCS	=	Advanced On-Board Computer System
ATC	=	U.S. Army Aberdeen Test Center
CFE	=	contractor-furnished equipment
DS	=	direct support
DTC	=	U.S. Army Developmental Test Command
DTP	=	Detailed Test Plan
EMP	=	electromagnetic pulse
FAT	=	First Article Test
FD/SC	=	Failure Definition/Scoring Criteria
GS	=	general support
HAEMP	=	high-altitude electromagnetic pulse
HFE	=	human factors engineering
HPD	=	horizontally polarized dipole
IPR	=	In-Process Review
MOPP	=	mission-oriented protective posture
NBC	=	nuclear, biological, chemical
NET	=	new equipment training
NIST	=	National Institute of Standards and Technology
OGL	=	overall grade level
PD	=	Purchase Description
PMCS	=	preventive maintenance checks and services
PP	=	power plant
REM	=	reliability, endurance, maintainability
RGL	=	reading grade level
ROC	=	Required Operational Capability
SPL	=	sound pressure level
SSP	=	system support package
TECOM	=	U.S. Army Test and Evaluation Command
TIR	=	Test Incident Report
TM	=	Technical Manual
TOP	=	Test Operations Procedure
TQG	=	tactical quiet generator
UMA	=	unscheduled maintenance action
VAC	=	volts alternating current

# APPENDIX E. DISTRIBUTION LIST

TECOM Project No. 8-EG-335-ECG-021

<u>Addressee</u>	<u>No. of Copies</u>
Commander U.S. Army Developmental Test Command ATTN: CSTE-DTC-TM-S	1
CSTE-DTC-TM-G	1
Aberdeen Proving Ground, MD 21005-5055	
Commander U.S. Army Communications - Electronics Command CCS Avionics Directorate ATTN: AMSEL-LC-CCS-P-GB	1
10115 Gridley Road, Suite 228 Fort Belvoir, VA 22060-5606	
Commander U.S. Army Communications - Electronics Command Night Vision Electronic Sensors Directorate ATTN: AMSEL-RD-NV-TE	1
10221 Burbeck Road Fort Belvoir, VA 22060-5806	
Commander U.S. Army Operational Test and Evaluation Command ATTN: CSTE-ECS	1
Park Center IV 4501 Ford Avenue Alexandria, VA 22302-1458	
Commander U.S. Army Combined Arms Support Command ATTN: ATCL-MEF	1
ATCL-A	1
ATCLO-O	1
801 Lee Avenue Fort Lee, VA 23801-6000	

<u>Addressee</u>	<u>No. of Copies</u>
Commander U.S. Army Materiel Command ATTN: AMCRD-S 5000 Eisenhower Avenue Alexandria, VA 22333-0001	1
Commander U.S. Army Training and Doctrine Command ATTN: ATCD-S 20 Whistler Lane, Bldg 134, Rm 101 Fort Monroe, VA 23651-5192	1
Commander U.S. Army Operational Test and Evaluation Command ATTN: CSTE-EAC-SV 4120 Susquehanna Avenue Aberdeen Proving Ground, MD 21005-3013	1
Commander U.S. Army Training and Doctrine Command Combat Development Engineering (CDE - Fort Lee Field Office) ATTN: ATCD-ENG-L 3901A Ave, Suite 250 Fort Lee, VA 23801-1890	1
HQDA (DACS-TE)	1
(DALO-SMS)	1
(DAMO-FDT)	1
(DAMO-FDL)	1
Washington, DC 20310-0001	
Project Manager - Mobile Electric Power ATTN: AMSEL-DSA-MEP	1
AMSEL-DSA-MEP-T	2
7798 Cissna Road, Suite 200 Springfield, VA 22150-3199	

<u>Addressee</u>	<u>No. of Copies</u>
Program Manager Combat Support Logistics Equipment ATTN: CSLE-UT 3033 Barnett Avenue, STE 315 Quantico, VA 22134-5010	1
Director Military Traffic Management Command Transportation Engineering Agency ATTN: MTTE-DPE 720 Thimble Shoals Blvd. Suite 130 Newport News, VA 23603-2574	1
Director U.S. Army Evaluation Center ATTN: CSTE-EAC-ILS CSTE-EAC-CS CSTE-EAC-RAM CSTE-EAC-AV/CS 4120 Susquehanna Avenue Aberdeen Proving Ground, MD 21005-3013	1 1 1 1
Commander U.S. Army Aberdeen Test Center ATTN: CSTE-DTC-AT-SF-S CSTE-DTC-AT-SC-A Aberdeen Proving Ground, MD 21005-5059	10 1
Defense Technical Information Center 8725 John J. Kingman Rd., STE 0944 Fort Belvoir, VA 22060-6218	2

Secondary distribution is controlled by Project Manager - Mobile Electric Power,  
 ATTN: AMCPM-MEP-T.